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FINAL

April 2016 Update to the Texas Water Quality Management Plan

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Prepared by the
Office of Water
Water Quality Division

Compiled and distributed by the
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WQMP updates are also available on the TCEQ web site at:

< *http://www.tceq.texas.gov/permitting/wqmp/WQmanagement_updates.html* >

Developed in accordance with Sections 205(j), 208,
and 303 of the Federal Clean Water Act
and applicable regulations thereto.

Texas Commission on Environmental Quality

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Introduction

The Texas Water Quality Management Plan (WQMP) is the product of a wastewater treatment facility planning process developed and updated in accordance with provisions of Sections 205(j), 208, and 303 of the federal Clean Water Act (CWA), as amended. The WQMP is an important part of the State's program for accomplishing its clean water goals.[1]

The Texas Department of Water Resources, a predecessor agency of the Texas Commission on Environmental Quality (TCEQ), prepared the initial WQMP for waste treatment management during the late 1970s. The Clean Water Act mandates that the WQMP be updated as needed to fill information gaps and revise earlier certified and approved plans. Any updates to the plan need involve only the elements of the plan that require modification. The original plan and its subsequent updates are collectively referred to as the State of Texas Water Quality Management Plan.

The WQMP is tied to the State's water quality assessments that identify priority water quality problems. The WQMPs are used to direct planning for implementation measures that control and/or prevent water quality problems. Several elements may be contained in the WQMP, such as effluent limitations of wastewater facilities, total maximum daily loads (TMDLs), nonpoint source management controls, identification of designated management agencies, and ground water and source water protection planning. Some of these elements may be contained in separate documents which are prepared independently of the current WQMP update process, but may be referenced as needed to address planning for water quality control measures.

This document, as with previous updates[2], will become part of the WQMP after completion of its public participation process, certification by the TCEQ and approval by the United States Environmental Protection Agency (EPA).

The materials presented in this document revise only the information specifically addressed in the following sections. Previously certified and approved water quality management plans remain in effect.

The April 2016 WQMP update addresses the following topics:

1. Projected Effluent Limits Updates for water quality planning purposes
2. Service Area Population for Municipal Wastewater Facilities
3. Designation of Management Agencies for Municipal Wastewater Facilities
4. Total Maximum Daily Load Updates

[1] A formal definition for a water quality management plan is found in 40 Code of Federal Regulations (CFR) 130.2(k).

[2] Fiscal Years 1974, 1975, 1977, 1978, 1979, 1980, 1981, 1982, 1983, 1984/85, 1986/88, 1989, 1990, 1991, 1992, 1993/94, 1995, 1996, 1997/98, 02/1999, 05/1999, 07/1999, 10/1999, 01/2000, 04/2000, 07/2000, 10/2000, 01/2001, 04/2001, 07/2001, 10/2001, 01/2002, 04/2002, 07/2002, 10/2002, 01/2003, 04/2003, 07/2003, 10/2003, 01/2004, 04/2004, 07/2004, 10/2004, 01/2005, 04/2005, 07/2005, 10/2005, 01/2006, 04/2006, 07/2006, 10/2006, 01/2007, 04/2007, 07/2007, 10/2007, 01/2008, 04/2008, 07/2008, 10/2008, 01/2009, 04/2009, 07/2009, 10/2009, 01/2010, 04/2010, 07/2010,10/2010, 01/2011, 04/2011, 07/2011, 10/2011, BPUB 2011, 01/2012, 04/2012, 07/2012,10/2012, 01/2013, 04/2013, 07/2013,10/2013, 01/2014, 04/2014, 07/2014, 10/2014, 01/2015, 04/2015, 07/2015, 10/2015, and 01/2016.

The public comment period for the April WQMP update was from May 13, 2016 through June 13, 2016.

The Projected Effluent Limit Update section provides information compiled from February 1, 2016 through April 31, 2016, and is based on water quality standards, and may be used for water quality planning purposes in Texas Pollutant Discharge Elimination System (TPDES) permit actions.

The Service Area Population and Designation of Management Agency sections for municipal wastewater facilities has been developed and evaluated by the TCEQ in cooperation with the Texas Water Development Board (TWDB) and regional water quality management planning agencies.

The Total Maximum Daily Load (TMDL) Update section provides information on proposed waste load allocations for new dischargers and revisions to existing TMDLs and has been developed by the Water Quality Planning Division, TMDL Program.

Projected Effluent Limit Updates

Table 1 reflects proposed effluent limits for new dischargers and preliminary revisions to original proposed effluent limits for preexisting dischargers (MGD-Million Gallons per Day, $CBOD_5$ – 5 Day Carbonaceous Biochemical Oxygen Demand, NH_3-N – Ammonia-Nitrogen, BOD_5 – 5 Day Biochemical Oxygen Demand and DO – Dissolved Oxygen).

Effluent flows indicated in Table 1 reflect future needs and do not reflect current permits for these facilities. These revisions may be useful for water quality management planning purposes. The effluent flows and constituent limits indicated in the table have been preliminarily determined to be appropriate to satisfy the stream standards for dissolved oxygen in their respective receiving waters. These flow volumes and effluent sets may be modified at the time of permit action. These limits are based on water quality standards (WQS) effective at the time of the TCEQ production of this update. WQS are subject to revision on a triennial basis.

Table 1. Projected Effluent Limit Updates

State Permit Number	Segment Number	EPA ID Number	Permittee Name County	Flow (MGD)	$CBOD_5$ (mg/L)	$CBOD_5$ (lbs/day)	NH_3-N (mg/L)	NH_3-N (lbs/day)	BOD_5 (mg/L)	BOD_5 (lbs/day)	DO (mg/L)	Months/ Comments
10304-001	0611	TX0033529	City of Troup Cherokee	0.308	20	51.37	3	7.71			4	
10350-001	2491	TX0023647	Laguna Madre Water District Cameron	1.10	10	91.74	3	27.52			4	Relocation of Outfall 001
10851-001	0701	TX0020460	Trinity Bay Conservation District Chambers	1.98	10	165.13	10	165.13			5	April-Sept.
				1.98	20	330.26	12	198.16			5	Oct.-March
11274-001	0607	TX0030813	West Hardin County CISD Hardin	0.008					20	1.33	2	Report NH_3-N
				0.015	10	1.25	3	0.38			6	
11826-001	0604	TX0068985	City of Hudson Angelina	0.98	10	81.73	2	16.35			5	
12242-001	1002	TX0084042	Porter MUD Montgomery	4.0	10	333.60	2	66.72			6	
12416-001	1012	TX0088137	Walnut Cove WSC Montgomery	0.125	10	10.43	3	3.13			4	
13147-001	0803	TX0098809	Sheffield, David Lee Polk	0.065					10	5.42	4	
13647-001	0839	TX0056588	City of Aubrey Denton	0.55	10	45.87	3	13.76			4	
14715-002	1245	TX0136875	Fort Bend Count MUD No. 134A Fort Bend	0.72	10	60.05	3	18.01			5	
14803-001	0818	TX0129623	Las Lomas MUD No. 4 of Kaufman County Kaufman	0.50	5	20.85	1	4.17			4	

State Permit Number	Segment Number	EPA ID Number	Permittee Name County	Flow (MGD)	$CBOD_5$ (mg/L)	$CBOD_5$ (lbs/day)	NH_3-N (mg/L)	NH_3-N (lbs/day)	BOD_5 (mg/L)	BOD_5 (lbs/day)	DO (mg/L)	Months/ Comments
15038-001	1806	TX0133914	City of Bulverde Comal	0.480	5	20.02	2	8.01			4	
15428-001	1245	TX0136786	Fort Bend County MUD No. 132 Fort Bend	0.90	10	75.06	3	22.52			6	
15433-001	1202	TX0136832	Land Tejas Companies, Ltd. Fort Bend	0.20	10	16.68	2	3.34			6	
15443-001	1014	TX0136883	Fulshear MUD No. 3B Waller	0.96	10	80.06	2	16.01			6	
15449-001	1202	TX0136913	JTI Constructors, Inc. Fort Bend	0.1875	10	15.64	3	4.69			4	
15454-001	1003	TX0136948	Sam Houston Area Council Boy Scouts of America San Jacinto	0.125	10	10.43	3	3.13			4	
15457-001	1804	TX0136972	Zipp Road Utility Co., L.L.C. Guadalupe	0.098	5	4.09	2	1.63			5	
15460-001	1009	TX0137014	Texas Providence Investments, L.L.C. Harris	0.008	10	0.67	3	0.20			6	

Planning Information Summary

The Water Quality Planning Division of the TCEQ coordinated with the TWDB and regional planning agencies to compile the wastewater facility information in this section. Domestic facility financing decisions under the State Revolving Loan Fund (SRF) program must be consistent with the certified and approved WQMP.

The purpose of this section is to present data reflecting facility planning needs, including previous water quality management plan needs requiring revision. Data are also presented to update other plan information for the TWDB's SRF projects. Table 2 contains the updated Service area population information. The table is organized in alphabetical order and includes the following 10 categories of information:

1. *Planning Area* – Area for which facility needs are proposed. The facility planning areas are subject to change during the facility planning process and any such changes will be documented in a later water quality management plan update. All planning areas listed are also designated management agencies (DMAs) unless otherwise noted in the "Comments" column.

2. *Service Area* – Area that receives the provided wastewater service.

3. *Needs* – A "T" indicates a need for either initial construction of a wastewater treatment plant, additional treatment capacity, or the upgrading of a wastewater treatment plant to meet existing or more stringent effluent requirements. A "C" indicates a need for improvements to, expansion of, rehabilitation of, or the initial construction of a wastewater collection system in the facility planning area. "T/C" indicates a need for both treatment and collection system facilities. More detailed facility planning conducted during a construction project may define additional needs and those needs will be reflected in a future update to the WQMP.

4. *Needs Year* – The year in which the needs were identified for the planning area.

5. *Basin Name* – The river basin or designated planning area where the entity is located. The seven water quality management planning areas designated by the Governor are Corpus Christi [Coastal Bend Council of Governments (CBCOG)], Killeen-Temple [Central Texas Council of Governments (CTCOG)], Texarkana [Ark-Tex Council of Governments (ATCOG)], Southeast Texas [South East Texas Regional Planning Council (SETRPC)], Lower Rio Grande Valley [Lower Rio Grande Valley Development Council (LRGVDC)], Dallas-Fort Worth [North Central Texas Council of Governments (NCTCOG)] and Houston [Houston-Galveston Area Council (H-GAC)]. Basin names are shown for agencies outside one of these areas.

6. *Segment* – The classified stream segment or tributary into which any recommended facility may discharge existing or projected wastewater. In the case of no-discharge facilities, this is the classified stream segment drainage area in which the facilities are located.

7. *County* – The county in which the facility planning area is located.

8. *Date* – The date the planning information was reviewed by the TCEQ.

9. *Comments* – Additional explanation or other information concerning the facility planning area.

10. *Population* – The base year and projected populations for each facility planning area. Population projections presented are consistent with the latest available statewide population projections or represent the most current information obtained from facility planning analyses.

The facility information in this section is intended to be utilized in the preparation of facility plans and the subsequent design and construction of wastewater facilities. Design capacities of the treatment and collection systems will be based upon the population projections contained in this document plus any additional needed capacity established for commercial/industrial flows and documented infiltration/inflow volumes (treatment or rehabilitation). The probable needs shown under the "Needs" heading are preliminary findings; specific needs for an area shall be as established in the completed and certified detailed engineering studies conducted during facility planning under the SRF and other state loan programs.

Specific effluent quality for any wastewater discharges resulting from any of the facilities recommended in this document will be in accordance with the rule on the Texas Surface Water Quality Standards in effect at the time of permit issuance for the specific facility.

Table 2. Service Area Population Updates

Planning Agency	Service Area	Needs	Needs Year	Basin Name / COG	Segment	County	WQMP Date	Comments	Year	Population
City of Cameron	City of Cameron	T/C	2018	Brazos River	1213	Milam	2/8/2016	Rehabilitation of lift stations and construction of a new WWTP.	2010	5,884
									2020	6,233
									2030	6,481
									2040	6,796
City of Houston	City of Houston	C	2016	San Jacinto River/HGAC	Various	Harris	2/26/2016	Replacement and rehabilitation of sewer lines.	2010	1,953,631
									2020	2,248,414
									2030	2,428,680
									2040	2,606,077
City of Wimberley	City of Wimberley	T/C	2035	Guadalupe River	1813	Hays	2/29/2016	WWTP expansion, construction of collection and reclaimed water distribution system.	2010	7,069
									2020	9,370
									2030	11,753
									2040	14,148
Sequoia Improvement District	Sequoia Improvement District	C	2016	San Jacinto River/HGAC	N/A	Harris	3/7/2016	Rehabilitation of collection lines and manholes.	2010	1,176
									2020	1,227
									2030	1,286
									2040	1,332

Designated Management Agencies

In order to be designated as a management agency for wastewater collection or treatment, an entity must demonstrate the legal, institutional, managerial and financial capability necessary to carry out the entity's responsibilities in accordance with Section 208 (c) of the Clean Water Act (see below list of requirements). Before an entity can apply for a state revolving fund loan, it must be recommended for designation as the management agency in the approved WQMP. Designation as a management agency does not require the designated entity to provide wastewater services, but enables it to apply for grants and loans to provide the services. The facilities listed in Table 3 have submitted Designated Management Agencies (DMA) resolutions to the TCEQ. The TCEQ submits this DMA information to the EPA for approval as an update to the WQMP.

Section 208 (c) (2) Requirements for Management Agency:

208(c)(2)(A): to carry out portions of an area-wide waste treatment plan.
208(c)(2)(B): to manage waste treatment works.
208(c)(2)(C): directly or by contract to design and construct new works.
208(c)(2)(D): to accept and utilize grants.
208(c)(2)(E): to raise revenues, including assessment of waste treatment charges.
208(c)(2)(F): to incur short and long term indebtedness.
208(c)(2)(G): to assure community pays proportionate cost.
208(c)(2)(H): to refuse to receive waste from non-compliant dischargers.
208(c)(2)(I): to accept for treatment industrial wastes.

Table 3. Designated Management Agencies

Planning Agency	Service Area	DMA Needs	DMA Date	DMA Area/Comments
City of Cameron	City of Cameron	T/C	12/21/2015	
Sequoia Improvement District	Sequoia Improvement District	C	5/11/2015	

Total Maximum Daily Load Updates

The Total Maximum Daily Load (TMDL) Program works to improve water quality in impaired or threatened waters bodies in Texas. The program is authorized by and created to fulfill the requirements of Section 303(d) of the federal Clean Water Act.

The goal of a TMDL is to restore the full use of a water body that has limited quality in relation to one or more of its uses. The TMDL defines an environmental target and based on that target, the State develops an implementation plan with waste load allocations for point source dischargers to mitigate anthropogenic (human-caused) sources of pollution within the watershed and restore full use of the water body.

The development of TMDLs is a process of intensive data collection and analysis. After adoption by the TCEQ, TMDLs are submitted to the EPA for review and approval.

The attached appendices may reflect proposed waste load allocations for new dischargers and revisions to TMDLs. To be consistent, updates will be provided in the same units of measure used in the original TMDL document. Also note that for bacteria TMDLs, loads may be expressed in counts for day, organisms per day, colony forming units per day, or similar expressions. These typically reflect different lab methods, but for the purposes of the TMDL program, these terms are considered synonymous.

Appendix I. Eighteen Total Maximum Daily Loads for Bacteria in Buffalo and Whiteoak Bayous and Tributaries For Segment Numbers 1013, 1013A, 1013C, 1014, 1014A, 1014B, 1014E, 1014H, 1014K, 1014L, 1014M, 1014N, 1014O, 1017, 1017A, 1017B, 1017D, and 1017E

TMDL Updates to the Water Quality Management Plan (WQMP): Buffalo and Whiteoak Bayous and Tributaries (Segments 1013, 1013A, 1013C, 1014, 1014A, 1014B, 1014E, 1014H, 1014K, 1014L, 1014M, 1014N, 1014O, 1017, 1017A, 1017B, 1017D, and 1017E)

The document *Eighteen Total Maximum Daily Loads for Bacteria in Buffalo and Whiteoak Bayous and Tributaries For Segment Numbers 1013, 1013A, 1013C, 1014, 1014A, 1014B, 1014E, 1014H, 1014K, 1014L, 1014M, 1014N, 1014O, 1017, 1017A, 1017B, 1017D, and 1017E* was adopted by the TCEQ on 04/08/09 and approved by EPA on 06/11/09, and became an update to the state's Water Quality Management Plan (WQMP). Seventeen subsequent WQMP updates prior to this one have updated the list of individual waste load allocations (WLAs) found in the original TMDL document. Additionally, two addenda to the original TMDL were submitted through the April 2013 and April 2015 WQMP updates. These addenda added two new assessment units (AUs) to the original TMDL project.

The purpose of this update is to make the following changes to the TMDL, presented in Table 1:

- Add a new permit.

The changes reflected in this update resulted in the shifting of allocations between the sum of the individual WLAs and the allowance for future growth (AFG) in one AU. This was originally presented in Table 53 in the TMDL document, and the affected AU is included here as Table 2.

In Table 54 of the TMDL, the WLAs for permitted facilities are the sum of the individual WLAs and the allowance for future growth within each AU. Therefore, these overall numbers did not change, and Table 54 of the TMDL remains the same.

Table 1 – Change to Individual Waste Load Allocation (Updates Table 45, pp. 99-103 in the TMDL document.)

State Permit Number	Outfall	EPA Permit Number	Segment Number	Permittee Name	Flow (MGD)	Waste Load Allocation (WLA) – *E. coli* in Billion MPN/day	TMDL Comments
15443-001	001	TX0136883	1014B_01	FULSHEAR MUD NO. 3B	0.96	2.289	New permit

Table 2 - *E. coli* TMDL Summary Calculations (Updates Table 53, pp. 118-119 in the TMDL document.)

Assessment Unit	TMDL (Billion MPN/day)	WLA_{WWTF} (Billion MPN/day)	$WLA_{StormWater}$ (Billion MPN/day)	LA (Billion MPN/day)	MOS (Billion MPN/day)	Upstream Load (Billion MPN/day)	Future Growth (Billion MPN/day)
1014B_01	626.91	95.33	482.44	38.6	0	0	10.54

Appendix II. Nine Total Maximum Daily Loads for Bacteria in Clear Creek and Tributaries: Segments 1101, 1101B, 1101D, 1102, 1102A, 1102B, 1102C, 1102D, and 1102E

TMDL Updates to the Water Quality Management Plan (WQMP): Clear Creek and Tributaries (Segments 1101, 1101B, 1101D, 1102, 1102A, 1102B, 1102C, 1102D, and 1102E)

The document *Nine Total Maximum Daily Loads for Bacteria in Clear Creek and Tributaries: Segments 1101, 1101B, 1101D, 1102, 1102A, 1102B, 1102C, 1102D, and 1102E* was adopted by the TCEQ on 09/10/08 and approved by EPA on 03/06/09, and became an update to the state's Water Quality Management Plan. It has had four subsequent WQMP updates prior to this one that provided individual Waste Load Allocations (WLAs) for permitted facilities. Additionally, an addendum to the original TMDL was submitted through the October 2012 WQMP update. This addendum added four new assessment units (AUs) to the original TMDL project.

The purpose of this update is to make the following change to the addendum to the TMDL, presented in Table 1:

- update the percentages of the areas of the subwatersheds of the AUs that are designated as urbanized areas in the Decennial Census.

The proportional area of each AU's subwatershed designated as a UA in the 2000 Decennial Census was used as part of the process to determine the percentage of the stormwater loading to be allocated to regulated sources (as an aggregate allocation for all permitted stormwater sources), referred to as the "WLA_{MS4}" in the TMDL addendum. Any remaining percentage was allocated to unregulated sources in the Load Allocation (LA) term. This update adjusts the stormwater allocation based on newer UA information from the 2010 Decennial Census.

The changes reflected in this update resulted in the shifting of allocations between WLA_{MS4} and LA terms in two AUs. These were originally presented in Tables 15 and 16 in the TMDL addendum, and the two affected AUs are updated here in Tables 2 and 3. The TMDL addendum appears in the October 2012 WQMP update as Appendix I, pages 10 through 33.

Table 1 - Percentage of MS4 Jurisdiction in the TMDL Area Watershed (Updates Table 7, p. 17 in Appendix I of the October 2012 WQMP update.)

Segment	Receiving Stream	TPDES Number	Total Area (Acres)	Area under MS4 Permit (Acres)	Percent of AU under MS4 Jurisdiction	TMDL Comments
1101A_01	Magnolia Creek	WQ0004685000	1,894	1,604	85%	Subwatershed designated as UA decreased from 100% to 85%
1101E_01	Unnamed Tributary of Clear Creek Tidal	WQ0004685000	2,340	2,340	100%	Subwatershed designated as UA increased from 42% to 100%

Table 2 - E. coli and Enterococcus TMDL Calculations for Tidal Segments (Updates Table 15, p. 27 in Appendix I of the October 2012 WQMP update.)
All loads expressed as billion MPN/day

Segment	Stream Name	Indicator	TMDL[a]	WLA_{WWTF}	WLA_{MS4}	LA	MOS	TMDL-Future[b]	$WLA_{WWTF\text{-}Future}$
1101A	Magnolia Creek	*Enterococcus*	95	16.77	62.5	11	4.75	99.4	4.38
1101A	Magnolia Creek	*E. coli* [c]	279	60.38	183.6	32.4	14	292	1.62
1101E	Unnamed Tributary of Clear Creek Tidal	*Enterococcus*	16.4	0	15.58	0	0.82	16.4	0.00

[a] This column is NOT the final TMDL total. It represents the TMDL before the incorporation of the allocation for future growth (presented as $WLA_{WWTF\text{-}Future}$ in this table). At the time of the TDML development, it was equal to the sum of the WLA_{WWTF}, WLA_{MS4}, LA, and MOS. Once allocation is shifted between the $WLA_{WWTF\text{-}Future}$ term and the WLA_{WWTF} term (as has happened for some AUs), the sum of the WLA_{WWTF}, WLA_{MS4}, LA, and MOS columns will no longer equal what is in the TMDL column here. However, the sum of those terms plus $WLA_{WWTF\text{-}Future}$ is equal to the amount in the TMDL-Future column. This is the final TMDL total presented in Table 16 in the original document, and discussed in footnote b that follows.

[b] Sum of the WLA_{WWTF}, WLA_{MS4}, LA, MOS, and $WLA_{WWTF\text{-}Future}$ terms that results in attainment of the geometric mean criterion. This is the final TMDL allocation, also presented in the table that follows.

[c] Because the listing for segment 1101A_01 is based on *E. coli*, the ENT allocations calculated using the tidal prism model were converted to EC using the 0.34 ENT/EC ratio.

Table 3 – Final TMDL Allocations (Updates Table 16, p. 28 in Appendix I of the October 2012 WQMP update.)
All loads expressed as billion MPN/day

Assessment Unit	Indicator	TMDL	WLA_{WWTF}	WLA_{MS4}	LA	MOS
1101A_01	*E. coli*	292	62.0	183.6	32.4	14.0
1101E_01	ENT	16.4	0	15.58	0	0.82

Appendix III. Two Total Maximum Daily Loads for Indicator Bacteria in Cottonwood Branch and Grapevine Creek For Segment Numbers 0822A and 0822B

TMDL Updates to the WQMP: Cottonwood Branch and Grapevine Creek (0822A and 0822B)

The document *Two Total Maximum Daily Loads for Indicator Bacteria in Cottonwood Branch and Grapevine Creek For Segment Numbers 0822A and 0822B* was adopted by the TCEQ on 09/21/11 and approved by EPA on 05/30/12, and became an update to the state's Water Quality Management Plan (WQMP). There have been no subsequent WQMP updates prior to this one.

The purpose of this update is to make the following change to the TMDL, presented in Table 1:

- update the percentage of the area of the subwatershed of one assessment unit (AU) that is designated as urbanized area in the Decennial Census.

The proportional area of the AU's subwatershed designated as a UA in the 2000 Decennial Census was used as part of the process to determine the percentage of the stormwater loading to be allocated to regulated sources (as an aggregate allocation for all permitted stormwater sources), referred to as the "WLA_{SW}" in the original TMDL document. Any remaining percentage was allocated to unregulated sources in the Load Allocation (LA) term. This update adjusts the stormwater allocation based on newer UA information from the 2010 Decennial Census.

The changes reflected in this update resulted in the shifting of allocations between WLA_{SW} and LA terms in one AU. This was originally presented in Tables 9 and 10 in the original TMDL document, and the affected AU is updated here in Tables 2 and 3.

Table 1 – Percentage of Stormwater Permit Jurisdiction in the TMDL Area Watershed (No corresponding table, but see text on page 10 in the original TMDL document)

Assessment Unit	AU Regulated Stormwater Area (ac.)	AU Drainage Area (ac.)	Percent Regulated Stormwater by AU 2010 Urbanized Area	TMDL Comments
0822B_01	7,594	7,594	100%	Subwatershed designated as UA increased from 84.8% to 100%

Table 2 - *E. coli* TMDL Allocation Summary (Updates Table 9, p. 25 in the TMDL document.)
All loads expressed in billion MPN/day

AU	Stream Name	TMDL	WLA_{WWTF}	WLA_{SW}	LA	MOS	Future Growth
0822B_01	Grapevine Creek	196.22	0.00	185.94	0	9.81	0.46

Table 3 - Final *E. coli* TMDL Allocations (Updates Table 10, p. 25 in the TMDL document)
All loads expressed in billion MPN/day

AU	Stream Name	TMDL	WLA_{WWTF}	WLA_{SW}	LA	MOS
0822B_01	Grapevine Creek	196.22	0.46	185.95	0	9.81

Appendix IV. Eight Total Maximum Daily Loads for Indicator Bacteria in Dickinson Bayou and Three Tidal Tributaries: Segments 1013, 1103A, 1103B and 1104

TMDL Updates to the WQMP: Dickinson Bayou and Tributaries (Segments 1103, 1103A, 1103B, 1103C, and 1104)

The document *Eight Total Maximum Daily Loads for Indicator Bacteria in Dickinson Bayou and Three Tidal Tributaries: Segments 1013, 1103A, 1103B and 1104* was adopted by the TCEQ on 02/08/12 and approved by EPA on 06/06/12, and became an update to the state's Water Quality Management Plan (WQMP). It has not had any subsequent WQMP updates prior to this one.

The purpose of this update is to make the following changes to the TMDL, presented in Table 1:

- update the percentages of the areas of the subwatersheds of the assessment units (AUs) that are designated as urbanized areas (UAs) in the Decennial Census.

The proportional area of each AU's subwatershed designated as a UA in the 2000 Decennial Census was used as part of the process to determine the percentage of the stormwater loading to be allocated to regulated sources (as an aggregate allocation for all permitted stormwater sources), referred to as the "$WLA_{Stormwater}$" in the original TMDL document. Any remaining percentage was allocated to unregulated sources in the Load Allocation (LA) term. This update adjusts the stormwater allocation based on newer UA information from the 2010 Decennial Census.

The changes reflected in this update resulted in the shifting of allocations between $WLA_{Stormwater}$ and LA terms in eight AUs. These were originally presented in Table 20 in the original TMDL document, and the eight affected AUs are updated here in Table 2.

Table 1 – Percentages of Each Assessment Unit Designated as an Urbanized Area (Updates Table 19, p. 40 in the TMDL document)

Assessment Unit	Area under MS4 (acres)	Total sub-watershed area (acres)*	Percentage of Assessment Unit Permitted for Stormwater	TMDL Comments
1104_01	1,198	7,487	16%	Subwatershed designated as UA increased from 6% to 16%
1104_02	3,537	12,695	28%	Subwatershed designated as UA decreased from 41% to 28%
1103_04	5,881	13,857	42%	Subwatershed designated as UA increased from 32% to 42%
1103_03	380	1,916	20%	Subwatershed designated as UA decreased from 27% to 20%
1103_02	7,456	12,130	61%	Subwatershed designated as UA increased from 34% to 61%
1103_01**	1,713	10,111	17%	Subwatershed designated as UA increased from 2% to 17%
1103A_01	3,128	3,128	100%	Subwatershed designated as UA increased from 48% to 100%
1103B_01	1,258	1,793	70%	Subwatershed designated as UA increased from 36% to 70%
1103C_01	1,812	2,136	85%	Subwatershed designated as UA increased from 26% to 85%

* Total subwatershed areas are also updated here, and will differ slightly from the original TMDL.

**1103_01 was included in Table 19 in the original TMDL document, but at the time the TMDL was being developed, it was not an impaired AU. A TMDL equation was not prepared for it, so it is not updated in Table 2 that follows.

Table 2 - TMDL Allocations for Dickinson Bayou Watershed (in MPN/day*)* (Updates Table 20, p. 44 in the TMDL document.)

Stream Name	Assessment Unit	Indicator Bacteria	TMDL	WLA_{WWTF}	$WLA_{Storm-Water}$	LA	MOS	Future Growth
Dickinson Bayou Above Tidal	1104_01	*E. coli*	3.70E+10	1.97E+09	5.23E+09	2.75E+10	1.82E+09	5.28E+08
Dickinson Bayou Above Tidal	1104_02	*E. coli*	1.04E+10	2.44E+09	1.50E+09	3.87E+09	4.11E+08	2.19E+09
Bensons Bayou	1103A_01	*Enterococci*	9.26E+09	0.00E+00	8.80E+09	0.00E+00	4.63E+08	0.00E+00
Bordens Gully	1103B_01	*Enterococci*	1.65E+09	0.00E+00	1.10E+09	4.69E+08	8.25E+07	0.00E+00
Geislers Bayou	1103C_01	*Enterococci*	4.14E+09	0.00E+00	3.34E+09	5.90E+08	2.07E+08	0.00E+00
Dickinson Bayou Tidal	1103_02	*Enterococci*	2.41E+11	3.22E+09	1.37E+11	8.78E+10	1.21E+10	8.03E+08
Dickinson Bayou Tidal	1103_03	*Enterococci*	9.41E+10	0.00E+00	1.79E+10	7.15E+10	4.70E+09	0.00E+00
Dickinson Bayou Tidal	1103_04	*Enterococci*	6.74E+10	0.00E+00	2.69E+10	3.71E+10	3.37E+09	0.00E+00

Appendix V. Fifteen Total Maximum Daily Loads for Indicator Bacteria in Watersheds Upstream of Lake Houston For Segment Numbers 1004E, 1008, 1008H, 1009, 1009C, 1009D, 1009E, 1010, and 1011

TMDL Updates to the Water Quality Management Plan (WQMP): Watersheds Upstream of Lake Houston (1004E, 1008, 1008H, 1009, 1009C, 1009D, 1009E, 1010, and 1011)

The document *Fifteen Total Maximum Daily Loads for Indicator Bacteria in Watersheds Upstream of Lake Houston For Segment Numbers 1004E, 1008, 1008H, 1009, 1009C, 1009D, 1009E, 1010, and 1011* was adopted by the TCEQ on 04/06/11 and approved by EPA on 06/29/11, and became an update to the state's Water Quality Management Plan (WQMP). Seventeen subsequent WQMP updates prior to this one have updated the list of individual waste load allocations (WLAs) found in the original TMDL document. Additionally, an addendum to the original TMDL was submitted through the October 2013 WQMP update. This addendum added six new assessment units (AUs) to the original TMDL project.

The purpose of this update is to make the following changes to the TMDL, presented in Table 1:

- add one new permit, and
- remove a withdrawn permit.

The changes reflected in this update resulted in the shifting of allocations between the sum of the individual WLAs and the allowance for future growth (AFG) in four AUs. This was originally presented in Table 18 in the original TMDL document, and the four affected AUs are included here as Table 2.

In Table 19 of the original TMDL, the WLAs for permitted facilities are the sum of the individual WLAs and the allowance for future growth within each AU. Therefore, these overall numbers did not change, and Table 19 of the TMDL remains the same.

Table 1 - Changes to Individual Waste Load Allocations (Updates Table 16, pp. 49-56 in the TMDL document.)

State Permit Number	Outfall	EPA Permit Number	Segment Number	Permittee Name	Flow (MGD)	Waste Load Allocation (WLA) – *E. coli* in Billion MPN/day	TMDL Comments
15434-001	001	TX0136841	1009E_01	TEXAS PROVIDENCE INVESTMENTS, LLC	NA	NA	Permit withdrawn (replaced by new permit 15460-001 /TX0137014)
15460-001	001	TX0137014	1009_02	TEXAS PROVIDENCE INVESTMENTS, LLC	0.008	0.019	New permit (replaces withdrawn permit 15434-001 /TX0136841; different discharge route)

Table 2 - *E. coli* TMDL Summary Calculations for Lake Houston Assessment Units (Updates Table 18, pp. 61 in the TMDL document.)

Assessment Unit	Sampling Location	Stream Name	TMDL (Billion MPN/ day)	WLA_{WWTF} (Billion MPN/ day)	$WLA_{StormWater}$ (Billion MPN/ day)	LA (Billion MPN/ day)	MOS (Billion MPN/ day)	Future Growth (Billion MPN/ day)
1009_02	11331	Cypress Creek	615	82.78	141	325	30.8	35.42
1009_03	11328	Cypress Creek	1340	168.23	299	690	67.0	115.77
1009_04	11324	Cypress Creek	1550	206.82	338	779	77.4	148.78
1009E_01	14159	Little Cypress Creek	91.1	12.28	5.16	59.4	4.56	9.70

Appendix VI. One Total Maximum Daily Load for Bacteria in Upper Oyster Creek for Segment Number 1245

TMDL Updates to the Water Quality Management Plan (WQMP): Bacteria in Upper Oyster Creek (Segment 1245)

The document *One Total Maximum Daily Load for Bacteria in Upper Oyster Creek for Segment Number 1245* was adopted by the TCEQ on 08/08/07 and approved by EPA on 09/28/07, and became an update to the state's Water Quality Management Plan (WQMP). Nine subsequent WQMP updates prior to this one have provided individual Waste Load Allocations (WLAs) for permitted facilities.

The purpose of this WQMP update is to make the following changes to the TMDL:

- add two new permits (Table 1),
- remove a withdrawn permit (Table 1),
- update the percentages of the areas of the subwatersheds of the Allocation Reaches that are designated as urbanized areas (UAs) in the Decennial Census (Table 2), and
- return the TMDL totals to the amounts in the original TMDL document (Tables 3 and 4).

Table 1 –Permitted Bacteria Allocation for Amended Discharges (pp. 35-37 in original TMDL document.)

State Permit Number	Outfall	EPA Permit Number	Segment Number	Permittee Name	Flow (MGD)	Waste Load Allocation (WLA)	TMDL/ Comments
14715-002	001	TX0136875	1245	FORT BEND COUNTY MUD #134A WWTP 2	0.72	1.07×10^{10} cfu *E. coli* per day	New permit
15428-001	001	TX0136786	1245	FORT BEND COUNTY MUD #132	0.9	1.34×10^{10} cfu *E. coli* per day	New permit
15091-001	001	TX0134562	1245	SAGE FULSHEAR EAST, LLC.	NA	NA	Permit withdrawn

Note that this TMDL was written for *E. coli* and that it used the single sample criterion of 394 cfu/100 mL. All of the permitted facilities covered by the original TMDL and subsequent WQMP updates have also been given a daily average for *E. coli* of 126 cfu/100 mL consistent with standard bacteria permitting practices for the state of Texas. In addition, watershed stakeholders are meeting annually to discuss water quality in Upper Oyster Creek related to this TMDL project (both instream data as well as self-reported data from permitted facilities), and may recommend stricter permit limits for *E. coli* in the future if deemed necessary.

The proportional area of each Allocation Reach's subwatershed designated as a UA in the 2000 Decennial Census was used as part of the process to determine the percentage of the stormwater loading to be allocated to regulated sources (as an aggregate allocation for all permitted stormwater sources), referred to as the "WLA Non-continuous" in the original TMDL document (Table 2). Any remaining percentage was allocated to unregulated sources in the Load Allocation (LA) Other term. This update adjusts the stormwater allocation based on newer UA information from the 2010 Decennial Census.

Table 2 – Percentage of Stormwater Permit Jurisdiction in the TMDL Area Watershed (Updates totals derived from Figure 17, p. 29 in the TMDL document.)

Allocation Reach	Area under MS4 Permit (ha)	Total Area (ha)	Percent of Allocation Reach under MS4 Jurisdiction	TMDL Comments
1	6,696	7,519	89.05%	Subwatershed designated as UA increased from 64.38% to 89.05%
2	9,414	20,102	46.83%	Subwatershed designated as UA increased from 25.70% to 46.83%

The changes reflected in this update resulted in the shifting of allocations between WLA Non-continuous and LA Other terms in both Allocation Reaches. These were originally presented in Tables 10 and 11 in the original TMDL document, and the new allocations are updated here in Tables 3 and 4.

Under the methodology developed in earlier WQMP updates, the addition of the discharges for the new facilities in Allocation Reach 2 would also change the TMDL equation for the reach, given in Table 11 of the TMDL document. Note that other changes have already taken place that affected this equation (as well as that of Allocation Reach 1), which have been outlined in previous WQMP Updates. The WLA Continuous for Allocation Reach 2 will now be 2.00×10^{11} cfu *E. coli* per day.

Under that methodology the Allowable Loading for Allocation Reach 2 would also have to increase to allow for the increased flow (and therefore increased allowable *E. coli* concentrations) in Upper Oyster Creek as a result of these new discharges. As established on pages 32 and 33 and in Table 9 of the TMDL document, this "additional loading" is determined by calculating the "…difference between loadings if WWTFs operated at their full allowable daily discharges and the loadings that would be allowable under the average WWTF discharges reported…" The actual average discharge data related to this increase in discharge are not available; therefore, it is not possible to calculate this additional loading at this time. However, as long as all new/increased discharges have *E. coli* concentrations at or below the criterion, they will result in a neutral impact on Segment 1245 by increasing stream flow while adding bacteria at concentrations meeting protective criteria, as explained in the Future Growth section of the TMDL document on page 37.

In this update, we are returning the total TMDL values to what they were in the original TMDL document. In order to do that, loading is being shifted from the WLA Non-continuous and the LA Other terms to the WLA Continuous term. This shifting of allocation for each Allocation Reach is done in such a way that the new WLA Non-continuous and LA Other terms maintain the new proportions outlined in Table 2, using the new 2010 Decennial Census information. The new TMDL equations for each Allocation Reach are presented in Tables 3 and 4, and reflect the return to the original TMDL totals for both reaches, the new WLA Non-continuous and LA Other values for both reaches, and the new WLA Continuous value for Allocation Reach 2 (as affected by the changes presented in Table 1).

Table 3 – TMDL allocation summary for Allocation Reach 1 (Updates Table 10, p. 35 in the TMDL document.) **(all units in billion cfu of *E. coli* per day)**

Allocation Reach	TMDL	WLA Continuous	WLA Non-continuous	LA Other	MOS
1	1,453	412	927	114	Implicit

Table 4 – TMDL allocation summary for Allocation Reach 2 (Updates Table 11, p. 37 in the TMDL document.)
(all units in billion cfu of *E. coli* per day)

Allocation Reach	TMDL	WLA Continuous	WLA Non-continuous	LA Other	MOS
2	1,682	200	694	788	Implicit

The original water quality sampling for the project was completed in 2005, and since then conditions in the watershed may have changed and there has been limited sampling to assess water quality. A new sampling project for Segment 1245 is underway. Sampling began in December 2015 and is scheduled to continue approximately monthly through August 2017. In addition to providing valuable information to concerned stakeholders in the watershed, this data would be useful to determine if future TMDL analyses are required.

Appendix VII. Two Total Maximum Daily Loads for Dissolved Oxygen in Upper Oyster Creek: Segment 1245

TMDL Updates to the Water Quality Management Plan (WQMP): Dissolved Oxygen in Upper Oyster Creek (Segment 1245)

The document *Two Total Maximum Daily Loads for Dissolved Oxygen in Upper Oyster Creek: Segment 1245* was adopted by the TCEQ on 07/28/10 and approved by EPA on 09/21/10, and became an update to the state's Water Quality Management Plan (WQMP). It has had four subsequent WQMP updates prior to this one.

The purpose of this update is to make the following changes to the TMDL, both in Table 1:

- add two new permits, and
- remove a withdrawn permit.

The allocations presented in this update were verified as satisfactory using the QUAL2K model used in establishing the original TMDL.

Table 1 –WLA for Upper Reach 1245_03 by Individual WWTF (Table 9, p. 29 in original TMDL document.)

Facility	TCEQ Permit No. EPA Permit No. Outfall No.	Final Permitted Discharge (MGD)	Allowable $CBOD_5$ Loading (kg/d) | (lb/d)	Allowable NH_3-N Loading (kg/d) | (lb/d)	Comments
FORT BEND COUNTY MUD #134A WWTP 2	WQ0014715-002 TX0136875 Outfall 001	0.72	27.25 | 60.09	8.18 | 18.03	New permit
FORT BEND COUNTY MUD #132	WQ0015428-001 TX0136786 Outfall 001	0.9	4.43 | 9.76	0.17 | 0.38	New permit*
SAGE FULSHEAR EAST, LLC.	WQ0015091-001 TX0134562 Outfall 001	NA	NA	NA	Permit withdrawn

* This discharge was not originally included in the TMDL analysis of this watershed. The discharge from this facility enters a tributary system of Segment 1245 containing a combination of stream-like and pooled waters that are outside the domain of the TMDL QUAL2K model. Uncalibrated model results indicate that the levels of oxygen-related constituents exiting the tributary system are at background levels before entering Segment 1245. Therefore, this discharge is not expected to negatively affect water quality in the Segment. The loadings presented in the table are not based on their permit limits, but instead reflect the same "background" concentrations (1.3 mg/L $CBOD_5$ and 0.05 mg/L NH_3-N) also used in the TMDL for facilities that used polishing ponds. Actual permit limits are presented in Table 2.

The relevant permit limits for these new facilities are provided in Table 2.

Table 2 – Permitted Loadings for Individual WWTFs (Corresponds to Table 3, p. 13 in original TMDL document.)

Facility	TCEQ Permit No. / EPA Permit No.	Final Permitted Discharge (MGD)	$CBOD_5$ (mg/L)	NH_3-N (mg/L)	Dissolved Oxygen (mg/L)
FORT BEND COUNTY MUD #134A	WQ0014715-002 TX0136875 Outfall 001	0.72	10	3	5
FORT BEND COUNTY MUNICIPAL UTILITY DISTRICT NO. 132	WQ0015428-001 TX0136786 Outfall 001	0.9	10	3	6

The TMDL summary equations must also be updated for carbonaceous biochemical oxygen demand ($CBOD_5$; Table 3) and ammonia nitrogen (NH_3-N; Table 4) for the new permits.

Table 3 - Summary of TMDLs for Upper Reach $CBOD_5$ (Table 13, p. 36 in original TMDL document.)

Source Category	Proposed (Full Permitted) Loading[1] (kg/d)	Allowable Loading[2] (kg/d)
1245_**03:**		
Waste Load Allocation	275.57	275.57
Load Allocation	96.00	96.00
Total Loading	371.57	371.57

Table 4 - Summary of TMDLs for Upper Reach NH_3-N (Table 14, p. 37 in original TMDL document.)

Source Category	Proposed (Full Permitted) Loading[1] (kg/d)	Allowable Loading[2] (kg/d)
1245_**03:**		
Waste Load Allocation	73.03	73.03
Load Allocation	3.69	3.69
Total Loading	76.72	76.72

1 Those facilities routing wastewater through polishing ponds are included in the total, assuming quality exiting the pond(s) is 1.3 mg/L CBOD5 and 0.05 mg/L NH3-N.

2 Allowable loading is determined using the QUAL2K model developed for the TMDL and existing/proposed discharges at limits necessary to meet the relevant dissolved oxygen criteria.

Note: As stated earlier, the allocations presented in this update were verified as satisfactory using the QUAL2K model (or the uncalibrated model in the case of one facility, as described in the footnote to Table 1) used in establishing the original TMDL. The original water quality sampling for the project was completed in 2005, and since then conditions in the watershed may have changed and there has been limited sampling to assess water quality. A new sampling project for Segment 1245 is underway. Sampling began in December 2015 and is scheduled to continue approximately monthly through August 2017. In addition to providing valuable information to concerned stakeholders in the watershed, this data would be useful to determine if a new modeling effort or revisions to the original modeling effort are required for future analyses.

Appendix VIII. Addendum One to Three Total Maximum Daily Loads for the Upper San Antonio Watershed

Seven Total Maximum Daily Loads for Bacteria in the Upper San Antonio Watershed

For Segments: 1910D, 1911B, 1911C, 1911D and 1911E
Assessment Units 1910D,_01, 1911B_01, 1911C_01, 1911C_02, 1911D_01, 1911D_02, and 1911E_01

Introduction

The Texas Commission on Environmental Quality (TCEQ) adopted the total maximum daily loads (TMDLs) *Three Total Maximum Daily Loads for Bacteria in the Upper San Antonio Watershed: Segments 1910, 1910A, and 1911* (TCEQ 2007) on 07/25/2007. The TMDLs were approved by the United States Environmental Protection Agency (EPA) on 09/25/2007. This document is an addendum to add seven additional assessment units (AUs) in five segments to the original TMDL document, and will be submitted to the EPA through a Water Quality Management Plan (WQMP) update. The public comment period for this addendum will be from May 13, 2016 through June 13, 2016.

This addendum includes new information specific to seven additional AUs located within the watershed of the approved TMDL project for bacteria in the Upper San Antonio River watershed. Concentrations of indicator bacteria in these seven AUs exceed the criteria used to evaluate attainment of the contact recreation standard. For background or other information for the five segments, please refer to the *Technical Support Document for Additions to the Upper San Antonio Watershed, San Antonio, Texas* (University of Houston 2015), which has additional details related to all aspects of this addendum. The document was completed in January 2015 and is available on the TCEQ Web page for the Upper San Antonio River <www.tceq.state.tx.us/assets/public/waterquality/tmdl/ 34uppersa/34-TSD-UpperSanAntonio-2015-01.pdf>

Refer to the original, approved TMDL document for details related to the overall project watershed as well as the methods and assumptions used in developing this TMDL addendum. This addendum focuses on the subwatersheds of the additional AUs, and it offers the details related to developing the TMDL allocations for the additional AUs, which were not addressed individually in the original document. These additional AUs are also covered by an implementation plan developed by stakeholders in the San Antonio area. The implementation plan addresses multiple watersheds in the Upper San Antonio River area.

Problem Definition

The TCEQ identified the bacteria impairment to the AUs included in this addendum in the 2010 and 2012 Texas Water Quality Inventory and 303(d) Lists (Table 1). The impaired AUs include Menger Creek (1910D_01), Apache Creek (1911B_01), Alazan Creek (1911C_01, 1911C_02), San Pedro Creek (1911D_01, 1911D_02), and Sixmile Creek (1911E_01). See Figure 1 for a map of these subwatersheds.

The Texas surface water quality standards (TSWQS) give numeric and narrative criteria to evaluate attainment of designated uses (TCEQ 2010). The basis for water quality targets for the TMDL developed in this report will be the numeric criteria for bacterial indicators from the 2010 TSWQS. *Escherichia coli* (*E. coli)* is the preferred indicator bacteria for assessing contact recreation use in freshwater.

A number of changes have occurred in the past 10 years that warrant refinements in how indicator bacteria data are used to support water quality assessments and TMDL development in Texas. Some key factors that influence which indicator bacteria to use for water quality assessment and TMDL development, as well as the period of record to use for the data, include:

- Changes in land cover and locations of Texas Pollution Discharge Elimination System (TPDES)-permitted facilities;
- A change of the indicator bacteria in the 2000 TSWQS from fecal coliform to *E. coli* for freshwater, and enterococci for marine waters;
- Refinements in TCEQ surface water quality monitoring (SWQM) procedures; and
- Changes in TCEQ guidance, *Assessing and Reporting Surface Water Quality in Texas.*

As a result of these evolving factors, the historical data used to support the TMDLs in this report have been narrowed, wherever possible, to use only *E. coli* data from 2007 through 2010.

Table 2 summarizes the ambient water quality data for the TCEQ SWQM stations on the impaired water bodies, and Figure 2 shows the station locations within the watershed.

For Menger Creek (Segment 1010D), the geometric mean criterion for *E. coli* was exceeded in 45 percent of the samples at the only SWQM station location at which *E. coli* data were collected within this subwatershed. The criterion was exceeded in the samples an average of 61 percent for Apache Creek (Segment 1911B), 48 percent for Alazan Creek (Segment 1911C), 53 percent for San Pedro Creek (Segment 1911D), and 46 percent for Sixmile Creek (Segment 1911E) in each subwatersheds' monitoring stations.

Watershed Overview

The Upper San Antonio watershed is part of the San Antonio River Basin, which encompasses most of the greater San Antonio area and the upstream and downstream areas that drain into the San Antonio River and its confluences. The San Antonio River Basin drains over 4,194 square miles of land, a large portion of which is in the city of San Antonio. The Upper San Antonio River watershed drains approximately one third of both Bexar and Wilson counties, as well as a small portion of Karnes County, however the impaired portion for the watershed lies entirely within Bexar County. Based on data from 2000 to 2012, this region of the Upper San Antonio watershed has an annual rainfall average of 31.7 inches per year. The annual average precipitation values for each subwatershed derived from PRISM data (PRISM 2006) in this portion of Texas range between 30.4 and 31.7 inches per year, as shown in Table 3.

The central portion of the Upper San Antonio River watershed is heavily developed, since it encompasses the city of San Antonio. The much smaller northern portion is sparsely developed and largely evergreen forest and shrub. A small southeastern portion is predominantly low intensity developed land, pasture/hay, and shrub with sparse cultivated cropland and open water, including Calaveras Lake and Victor Braunig Lake. Table 4 summarizes the percentages of the land cover categories for the contributing subwatershed associated with each impaired AU in the Upper San Antonio watershed. The land cover data were retrieved from the U.S. Geological Survey (USGS) land cover database obtained from the USGS National Map Viewer (USGS 2006). The total acreage of each AU in Table 4 corresponds to the watershed delineation shown in Figure 3. The predominant land cover category in the subwatersheds is developed land (between 92 percent and 100 percent), followed by shrub/scrub (between 0 percent and 4 percent), evergreen forest (between 0 percent and 1 percent), and pasture/hay (between 0 percent and 0.2 percent). Open water and barren land account for less than 1 percent of the assessment units. The land cover for each subwatershed is shown in Figure 3.

Population estimates and future population projections were examined for counties and cities in the project area. These are discussed in the original TMDL document as well as the Technical Support Document for this addendum.

Table 1. Synopsis of Texas 2012 303(d) List for Water Bodies in the Upper San Antonio Watershed

Assessment Unit	Segment Name	Description	Category	Year First Listed
1910D_01	Menger Creek	From the confluence with Segment 1910 to the upper end of the water body	5c	2012
1911B_01	Apache Creek	From the confluence with San Pedro Creek up to just upstream of the confluence with Zarzamora Creek	5a	2010
1911C_01	Alazan Creek	From the confluence with Apache Creek up to the confluence with Martinez Creek	5a	2010
1911C_02	Alazan Creek	From just upstream of the confluence with Martinez Creek to the upper end of the segment	5a	2010
1911D_01	San Pedro Creek	From the confluence with Segment 1911 up to the confluence with Apache Creek	5a	2010
1911D_02	San Pedro Creek	From the confluence with Apache Creek to the upper end of the segment, NHD RC 12100301000867	5a	2010
1911E_01	Sixmile Creek	From the confluence with 1911 to the upper end of the water body at NHD RC 12100301000061	5c	2012

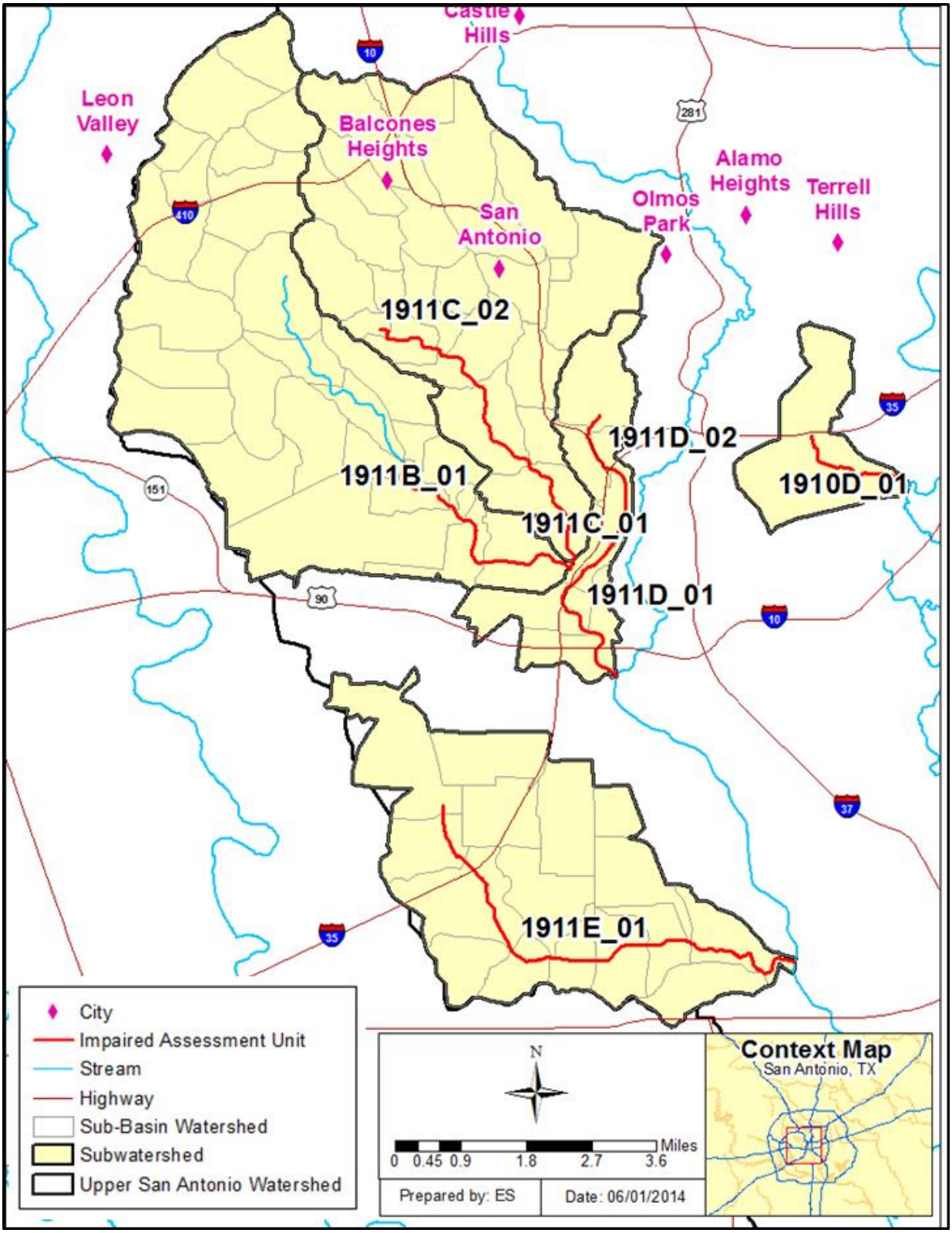

Figure 1. Location Map for Impaired Regions of the Upper San Antonio Watershed Region

Table 2. Historical Water Quality Data for the TCEQ Stations from 2007 to 2012

Segment	Station ID	Indicator Bacteria	Geometric Mean Concentration (MPN/100ml)	Number of Samples	Number of Samples Exceeding Single Sample Criterion	% of Samples Exceeding
1910D	12693	EC	485.23	22	10	45%
1911B	12710	EC	521.06	6	4	67%
	15707	EC	1199.74	6	4	67%
	18735	EC	522.96	46	23	50%
	20604	EC	1193.71	6	3	50%
	20605	EC	894.34	6	4	67%
	20606	EC	935.03	6	4	67%
1911C	12715	EC	316.64	43	17	40%
	12716	EC	159.68	6	3	50%
	12718	EC	344.47	6	2	33%
	18737	EC	321.30	6	3	50%
	20344	EC	646.24	6	3	50%
	20345	EC	740.68	6	4	67%
1911D	12709	EC	77.64	23	4	17%
	18736	EC	327.25	45	19	42%
	20116	EC	446.44	6	2	33%
	20117	EC	539.80	28	15	54%
	20119	EC	504.27	31	15	48%
	20120	EC	1406.59	6	6	100%
	20121	EC	908.12	6	5	83%
1911E	12705	EC	385.10	24	11	46%

EC: E. coli
Geometric Mean Criteria: 126 MPN/100 ml for EC
Single Sample Criteria: 399 MPN/100 ml for EC
Geometric mean concentrations were calculated assuming one-half the value of any concentration reported as less than the detection limit.
**MPN: most probable number*

Table 3. PRISM Annual Average Precipitation, 1981-2010

Segment Name	Segment	Average Annual (Inches)
Menger Creek	1910D	31.6
Apache Creek	1911B	31.1
Alazan Creek	1911C	31.7
San Pedro Creek	1911D	31.1
Sixmile Creek	1911E	30.4

Source: PRISM Group 2006

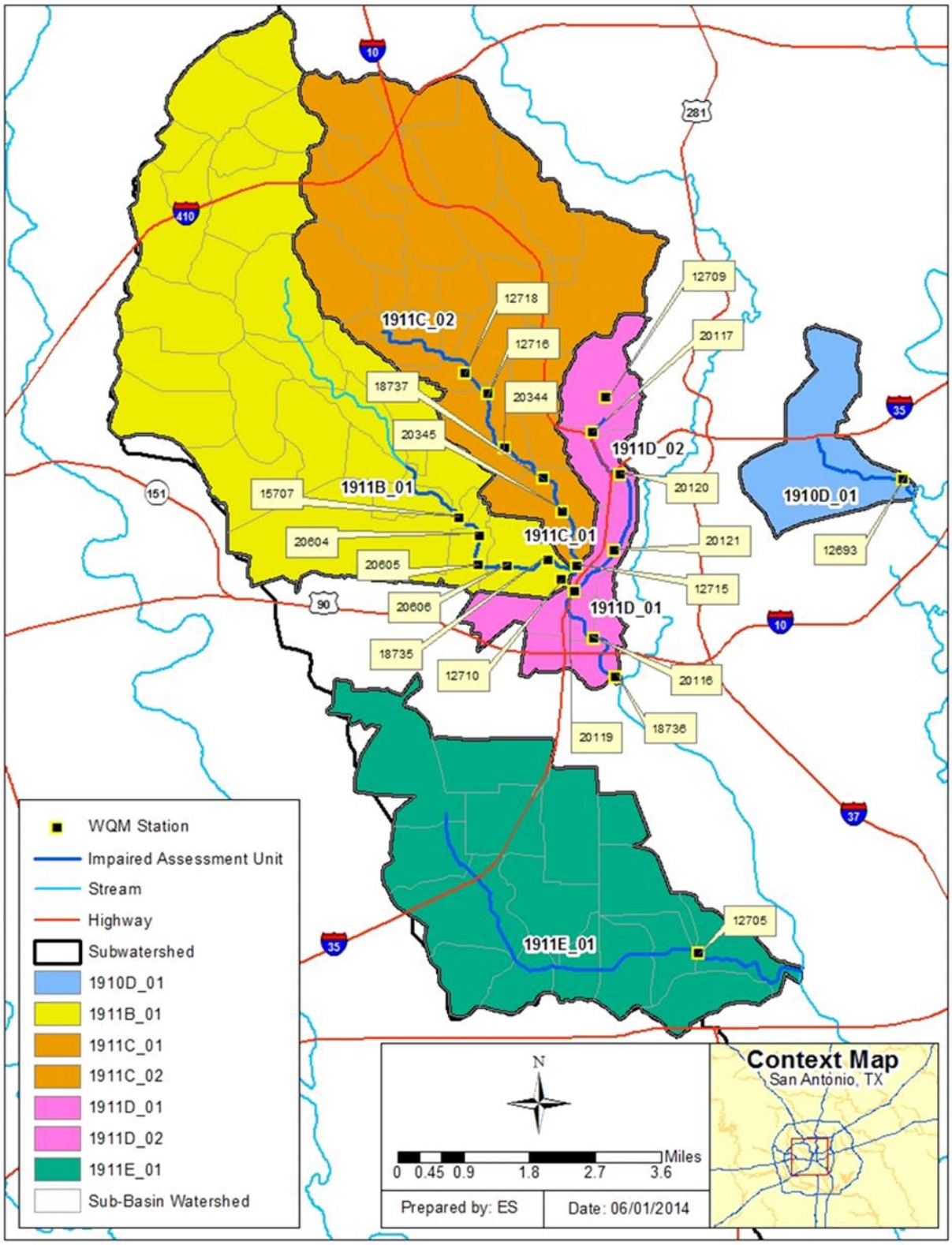

Figure 2. SWQM Station Locations

Table 4. Aggregated Land Cover Summaries by Assessment Unit

Aggregated Land Cover Category	Segment Name and Assessment Unit ID						
	Menger Creek	Apache Creek	Alazan Creek		San Pedro Creek		Sixmile Creek
Assessment Unit	1910D_01	1911B_01	1911C_01	1911C_02	1911D_01	1911D_02	1911E_01
Watershed Area (acres)	1959	14559	11231		2993		9532
Percent Open Water	0%	0.2%	0.3%		0%		0.08%
Percent Developed, Open Space	25.8%	25.3%	14.3%		10.6%		28.18%
Percent Developed, Low Intensity	31.6%	39%	48.1%		29.2%		34.36%
Percent Developed, Medium Intensity	24.2%	20.5%	21.6%		26%		16.5%
Percent Developed, High Intensity	18.4%	12.5%	15.1%		33.2%		13.61%
Percent Barren Land (Rock/sand/clay)	0%	0%	0%		0%		0%
Percent Deciduous Forest	0%	0.7%	0%		0%		0.8%
Percent Evergreen Forest	0%	0.3%	0.3%		0%		1.2%
Percent Mixed Forest	0%	0%	0%		0%		0.3%
Percent Shrub/Scrub	0%	0.9%	0.1%		0.44%		3.7%
Percent Grassland/Herbaceous	0%	0.3%	0.2%		0.53%		0.27%
Percent Pasture/Hay	0%	0%	0%		0%		0.2%
Percent Cultivated Crops	0%	0%	0%		0%		0.08%
Percent Woody Wetlands	0%	0.3%	0%		0%		0.72%
Percent Emergent Herbaceous Wetlands	0%	0%	0%		0%		0%

All information derived from USGS data: <http://viewer.nationalmap.gov/viewer/>

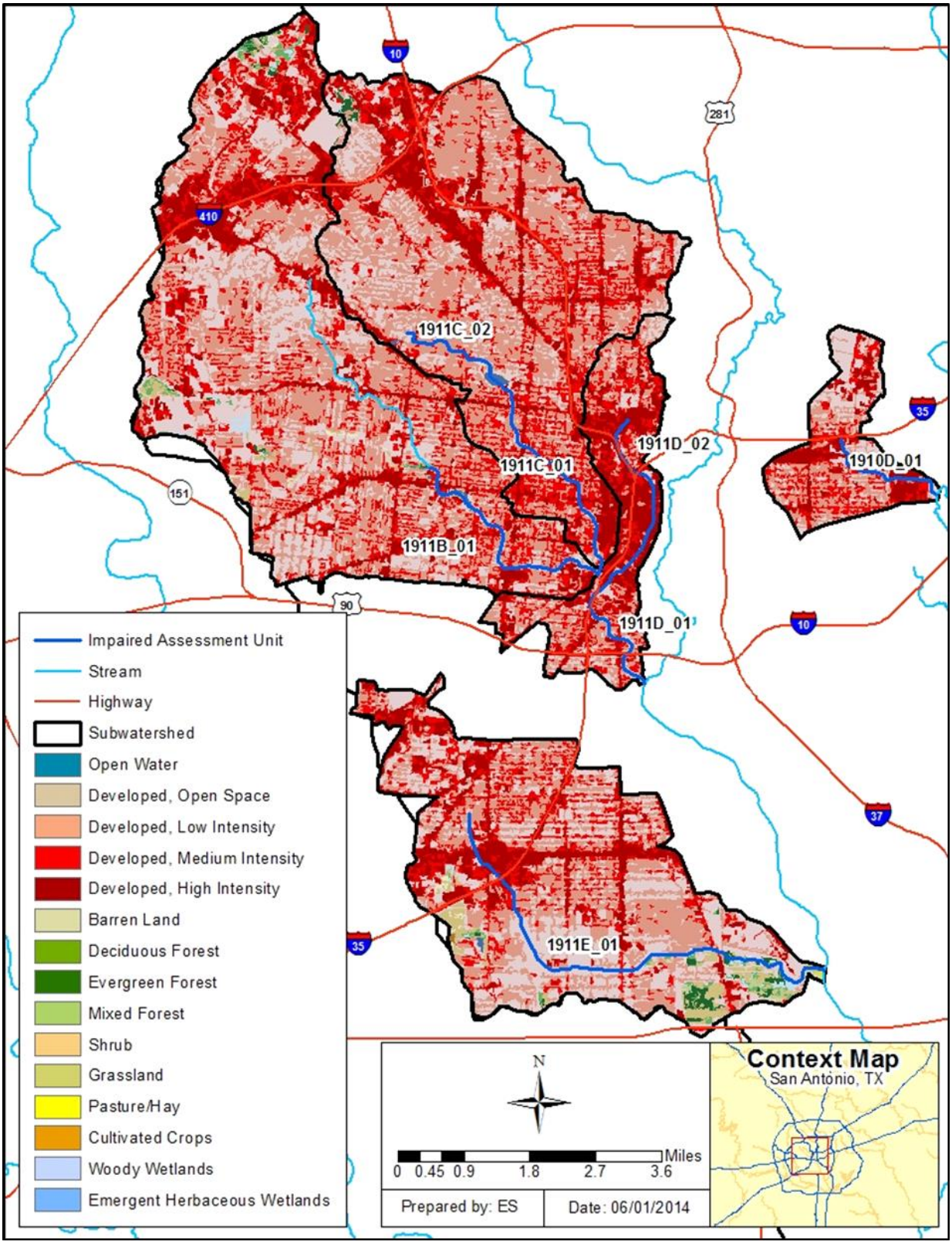

Figure 3. Land Cover Map

Endpoint Identification

The water quality target for the TMDLs for these seven freshwater AUs is to maintain concentrations below the geometric mean criterion of 126 MPN/100 mL for *E. coli*. The TMDL will be based on bacteria allocations required to meet this geometric mean criterion.

Source Analysis

Regulated Sources

One subwatershed in the area, Sixmile Creek (1911E_01) has two National Pollution Discharge Elimination System (NPDES)/TPDES-permitted sources, as shown in Figure 4. The entire area is regulated under the TPDES stormwater discharge permit jointly held by the City of San Antonio, San Antonio Water System (SAWS), and the Texas Department of Transportation (TxDOT). There are no NPDES-permitted concentrated animal feeding operations within the area. As shown in Table 5, the permitted flow associated with the continuously discharging facility Kelly Air Force Base was 1.0 million gallons per day (MGD) (TCEQ 2014). The regulated San Antonio Equipment Repair and Maintenance Yard facility in the watershed does not have large continuous discharges.

TPDES-permitted facilities that discharge treated wastewater are required by their permit to monitor their effluent for certain parameters. A summary of the discharge monitoring report (DMR) data for the Kelly Air Force Base facility is shown in Table 6.

Table 5. TPDES-Permitted Facilities in the subwatershed

Assessment Unit	Receiving Water	TPDES Number	NPDES Number	Facility Name	Facility Type	DTYPE	Permitted Flow (MGD)	Average Monthly Flow (MGD)
1911E	Sixmile Creek	03955-000	TX0116114	Kelly Air Force Base	Sewerage System	W	1	0.11
1911E	Sixmile Creek	04117-000	TX0069931	San Antonio Equipment Repair and Maintenance Yard	Industrial Stormwater	n/a	n/a	n/a*

Source: TCEQ Wastewater Outfall Shapefile, May 2014, EPA, TCEQ monitoring data search May 2014
MGD = Millions of Gallons per Day; n/a = Not Applicable
TYPE: D = Domestic < 1 MGD; W=Domestic >= 1 MGD
**This is not a WWTF, so there is no discharging effluent for the WLA. The facility holds a stormwater permit only.*

Sanitary Sewer Overflows

The TCEQ maintains a database of sanitary sewer overflow (SSO) data collected from wastewater operators in the Upper San Antonio River watershed. TCEQ Region 13 (San Antonio) provided SSO data for the Upper San Antonio River watershed, which are shown in Table 7 for 2010 through 2012.

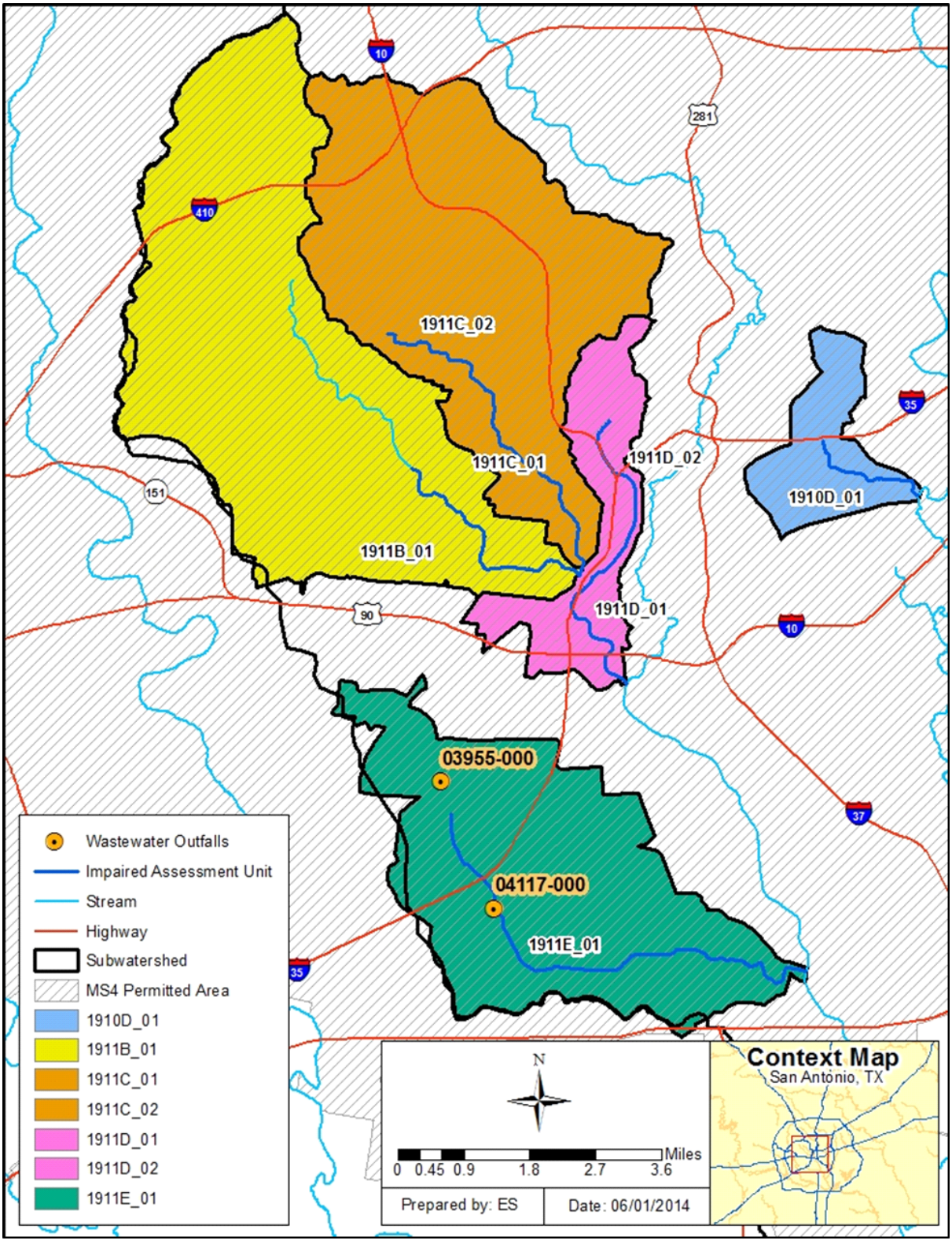

Figure 4: TPDES-Permitted Facilities that discharge into the Upper San Antonio Watershed

Table 6. DMR Data for Permitted Wastewater Discharges

TPDES Number	NPDES Number	Facility Name	Assessment Unit	Stream Name	Dates Monitored		# of Records	Monthly Average Flow (MGD)*	Permitted Flow (MGD)
					Start	End			
03955-000	TX0116114	Kelly Air Force Base	1911E	Sixmile Creek	n/a	n/a	n/a	0.11	1

Source: DM) Pollutant Loading Tool (http://cfpub.epa.gov/dmr/facility_detail.cfm)
*Notes: n/a = Not Available, MGD = Millions of Gallons per Day, cfu = colony forming unit; *there were several missing monthly flow data points; these gaps were filled by taking average of flows for the previous and subsequent months.*

The Leon Creek and Dos Rios facilities provide wastewater services within the subwatershed areas. However, the facilities discharge into other watersheds and are not included in the regulated facilities calculation for this TMDL. Information on sanitary sewer overflow is considered as a potential for impacting water quality.

The locations and magnitudes of all reported SSOs within the Upper San Antonio River watershed region are displayed, along with wastewater treatment facilities (WWTF) service area boundaries, in Figure 5. These numbers represent only a potential for compromising water quality, since not all overflows actually reach the water body.

As shown in Table 7, there have been approximately 207 sanitary sewer overflows reported in the Upper San Antonio River watershed since January 2010. The reported SSOs averaged 39,773 gallons per event.

Table 7. SSO Summary

Facility Name	NPDES Permit No.	Facility ID	Number of Occurrences	Date Range		Amount (Gallons)	
				From	To	Min	Max
Leon Creek WRC	TX0077801	10137-033	36	1/1/2010	8/31/2012	10	54,000
Dos Rios WRC	TX0052639	10137-003	171	1/1/2010	8/26/2012	1	3,570,000

TPDES-Regulated Stormwater

Within this area of the Upper San Antonio River watershed, there is one individual Phase I municipal separate storm sewer system (MS4) permit that is currently regulated by the TCEQ. This MS4 is operated by the City of San Antonio, SAWS, and TxDOT (Phase I permit).

The coverage area for this permit is displayed in Figure 4, which shows that the entire area for these subwatersheds is covered under the City of San Antonio/SAWS/TxDOT MS4 permit (TPDES Permit No. WQ0004284000, NPDES Permit No. TXS001901).

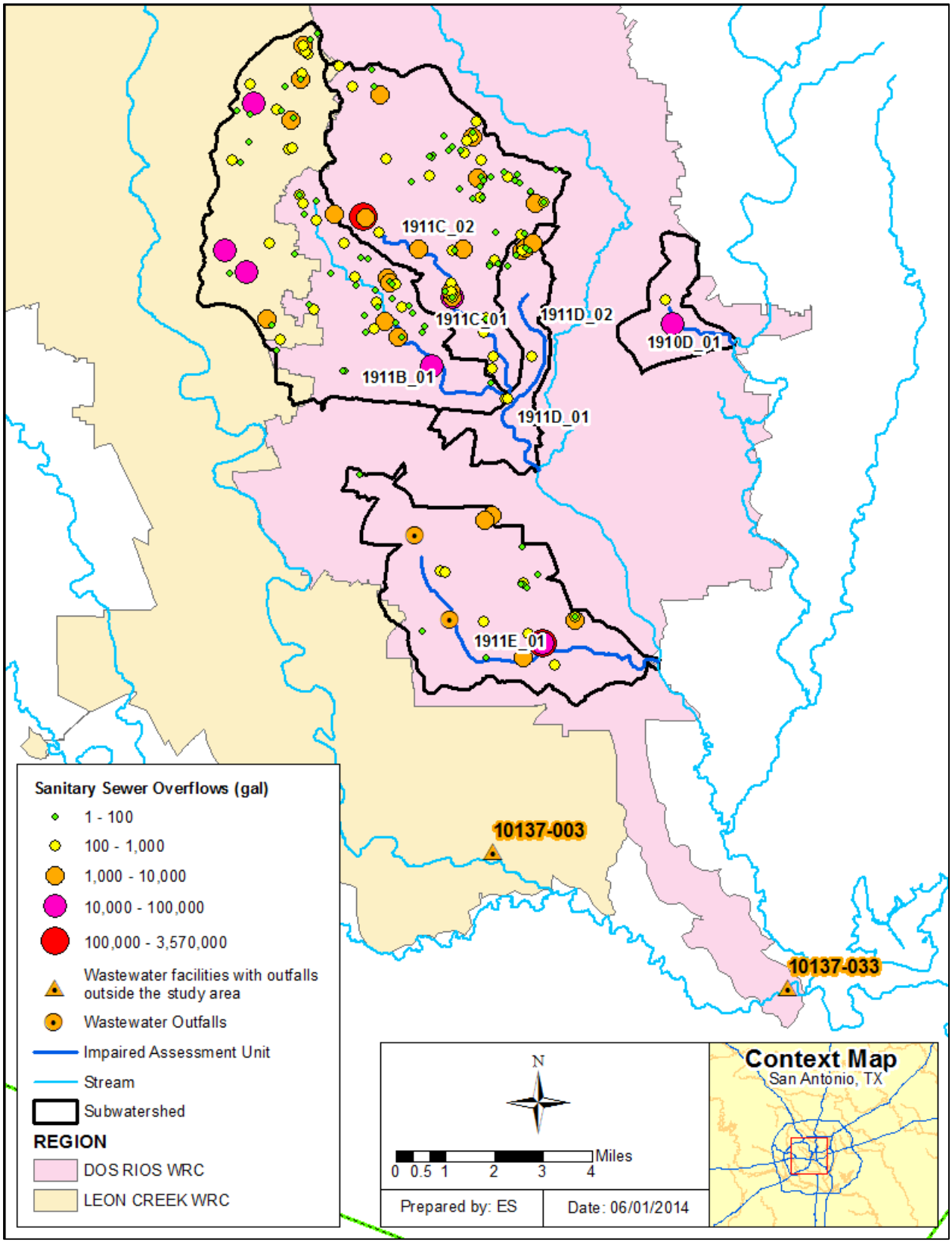

Figure 5. Locations of Sanitary Sewer Overflows

Unregulated Sources

Pollutants from unregulated sources enter the impaired AUs through distributed, nonspecific locations, which may include urban runoff not covered by a permit, wildlife, various agricultural activities and animals, land application fields, failing onsite sewage facilities (OSSFs), and domestic pets.

Wildlife and Unmanaged Animal Contributions

The portions of shrub and evergreen forest and sources of water in the area are a habitat for many species of wildlife such as mammals and birds, which are sources of bacteria. There are currently insufficient data available to estimate populations and spatial distribution of wildlife and avian species by subwatershed. Consequently, it is difficult to assess the magnitude of bacteria contributions from wildlife species as a general category.

Unregulated Agricultural Activities and Domesticated Animals

There are a number of unregulated agricultural activities that can also be sources of fecal bacteria loading. Agricultural activities of greatest concern are typically those associated with livestock operations (Drapcho and Hubbs 2002).

The estimated numbers of selected livestock by watershed were calculated based on the 2007 United States Department of Agriculture county agricultural census data (USDA 2007). The county-level estimated livestock populations were distributed throughout the subwatershed based on Geographic Information System (GIS) calculations of pasture land per watershed, based on the National Land Cover Database (National Oceanic and Atmospheric Administration 2011). It should be noted that these are planning-level livestock numbers and are not evenly distributed across counties or constant with time.

Cattle are estimated to be the most abundant species of livestock in the area. Livestock numbers and their associated bacteria loading are expected to decrease over time as more land is converted from grazing to developed urban uses in the Upper San Antonio River watershed. Using the estimated livestock populations and the fecal coliform production rates from the American Society of Agricultural Engineers, an estimate of fecal coliform production from each group of livestock was calculated for each subwatershed of the area. It should be noted that only a fraction of these fecal coliform loading estimates are expected to reach the receiving water, either washed into streams by runoff or by direct deposition from wading animals. Cattle appear to represent the most significant livestock source of fecal bacteria based on overall loading estimates for Sixmile Creek. The remaining subwatersheds are in highly urbanized areas, so livestock are likely to be an insignificant source of bacteria loading.

Failing On-site Sewage Facilities

OSSFs can be a source of bacteria loading to streams and rivers. Bacteria loading from failing OSSFs can be transported to streams in a variety of ways, including runoff from surface ponding or through groundwater. Indicator bacteria-contaminated groundwater can also be discharged to creeks through springs and seeps.

Over time, most OSSFs operating at full capacity will fail if not properly maintained. The 1995 American Housing Survey conducted by the U.S. Census Bureau estimates that, nationwide, 10 percent of occupied homes with OSSFs experience malfunctions during the year (U.S. Census Bureau 1995). A statewide study conducted by Reed, Stowe & Yanke, LLC (2001) reported that approximately 12 percent of the OSSFs in Bexar County were chronically malfunctioning. Most studies estimate that the minimum lot size necessary to ensure against contamination is roughly

one-half to one acre (Hall 2002). Some studies, however, found that lot sizes in this range or even larger could still cause contamination of ground or surface water (University of Florida 1987). It is estimated that areas with more than 40 OSSFs per square mile (6.25 septic systems per 100 acres) can be considered to have potential contamination problems (Canter and Knox 1985).

Only regulated OSSF systems are recorded by authorized county or city agents; therefore, it is difficult to estimate the exact number of OSSFs in use in the subwatersheds. Table 8 lists the OSSF totals based on GIS data given by the Bexar County Public Works Department. Figure 6 displays all regulated OSSF systems. It should be noted that any unsewered areas fall under the purview of wastewater service areas in the subwatersheds.

To estimate fecal coliform loading in watersheds, the OSSF failure rate of 12 percent from the Reed, Stowe & Yanke, LLC (2001) report for Texas On-Site Wastewater was used. Bexar County is located at the tripoint between Texas Regions 2, 3, and 4, and the report states that the failure rates are 12 percent, 3 percent, and 12 percent for those regions, respectively. The land cover in the area is most similar to Texas Regions 2 and 4, so the 12 percent failure rate was used for this study. Using this 12 percent failure rate, calculations were made to characterize fecal coliform loads in each watershed.

Fecal coliform loads were estimated using the following equation. (EPA 2001):

$$\#\frac{counts}{day} = \left(\#\,Failing\_systems\right) \times \left(\frac{10^6\,counts}{100ml}\right) \times \left(\frac{60gal}{personday}\right) \times \left(\#\frac{person}{household}\right) \times \left(3785.2\frac{ml}{gal}\right)$$

The average number of people per household was calculated to be 2.66 for the subwatersheds' area based on an average household density for the census blocks within the area (U.S. Census Bureau 2010). Sixty gallons of wastewater were estimated to be produced on average per person per day as the flow rate for a residential home in the United States (Metcalf and Eddy 1991). The fecal coliform concentration in failing septic tank effluent was estimated to be 10^6 per 100 mL of effluent based on reported concentrations from a number of published reports (Metcalf and Eddy 1991; Canter and Knox 1985; Cogger and Carlile 1984). Using this information, the estimated load from failing septic systems within each subwatershed was calculated and is summarized in Table 8. Based on this data, it was determined that the estimated fecal coliform loading from OSSFs in the area was found to be negligible.

Table 8. Estimated Number of OSSFs per Watershed and Fecal Coliform Load

Segment	Stream Name	Number of authorized OSSFs in the area	# of Failing OSSFs	Estimated Loads from OSSFs (billion counts/day)
1910D	Menger Creek	0	0	0
1911B	Apache Creek	95	11.4	68.87
1911C	Alazan Creek	34	4.08	24.65
1911D	San Pedro Creek	2	0.24	1.45
1911E	Sixmile Creek	29	3.48	21.02

Data from Bexar County Public Works Department

Domestic Pets

Fecal matter from dogs and cats is transported to streams by runoff from urban and suburban areas and can be a source of bacteria loading. On average nationally, there are 0.58 dogs per household and 0.66 cats per household (American Veterinary Medical Association 2002). Using the U.S. Census data at the block level (U.S. Census Bureau 2010), dog and cat populations can be estimated for each subwatershed. Table 9 summarizes the estimated number of dogs and cats for each of the subwatersheds.

Table 9. Estimated Numbers of Pets

Segment	Stream Name	Dogs	Cats
1910D	Menger Creek	2,386	2,715
1911B	Apache Creek	26,891	30,601
1911C	Alazan Creek	24,713	28,122
1911D	San Pedro Creek	5,987	6,813
1911E	Sixmile Creek	11,714	13,330

Since many pet owners dispose of their cat's waste indoors and clean up after their dogs outside, only a small portion of these loads is expected to reach water bodies, through wash-off of land surfaces and conveyance in runoff.

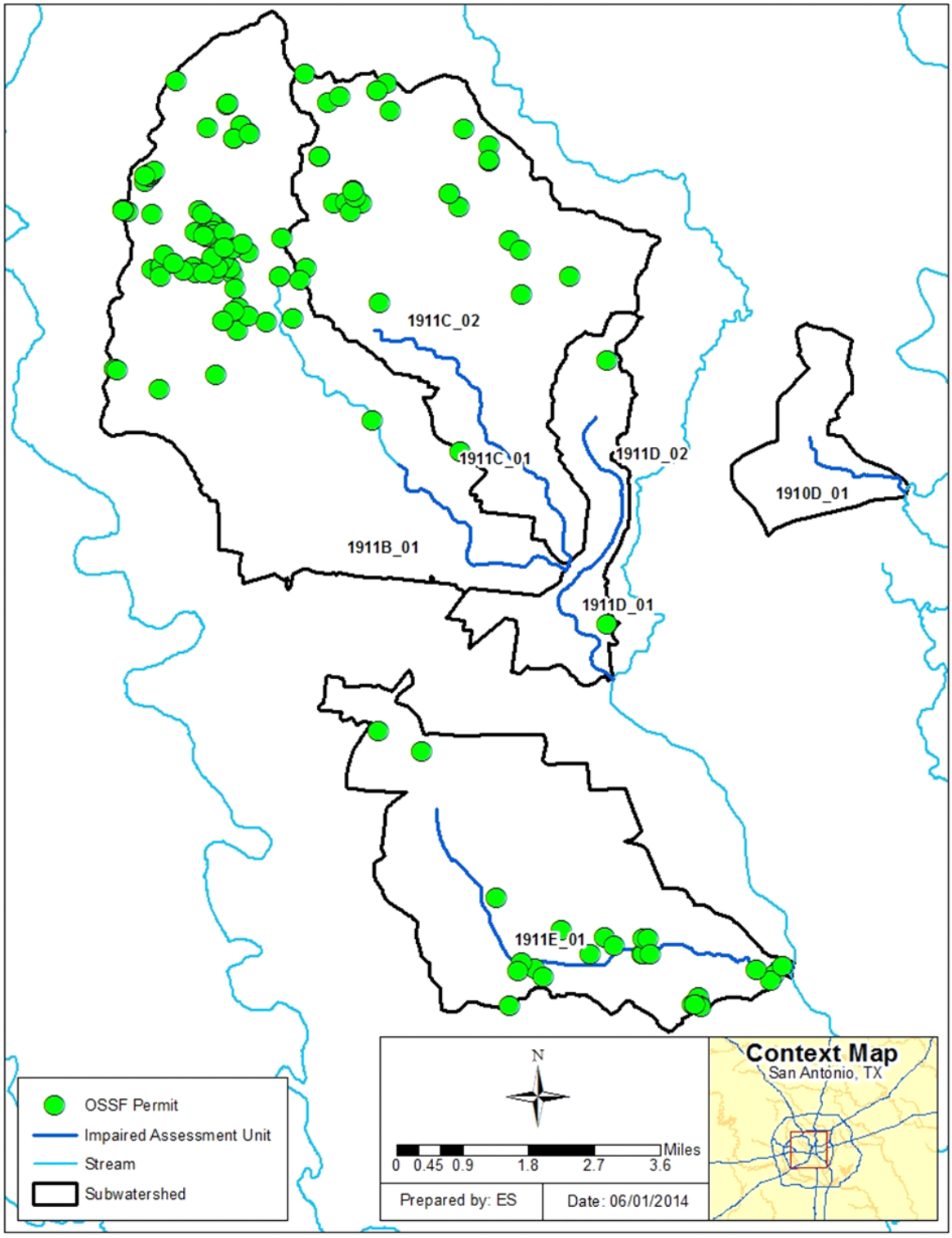

Figure 6. Unsewered Areas and Subdivisions with OSSFs

Linkage Analysis

Load duration curve (LDC) analysis (including flow duration curve (FDC) analysis) was used for analyzing indicator bacteria load and instream water quality for the segments in this project (EPA 2007). The Technical Support Document has details about this analysis.

Margin of Safety

The TMDL covered by this report incorporates an explicit margin of safety (MOS) by setting a target for indicator bacteria loads that is 5 percent lower than the single sample criterion. For contact recreation, using this MOS equates to a single sample target of 379 MPN/100mL for *E. coli* and a geometric mean target of 120 MPN/100mL. The net effect of the TMDL with the MOS is that the assimilative capacity or allowable pollutant loading of the water body is slightly reduced. The TMDL covered by this report incorporates an explicit MOS in each LDC by using 95 percent of the single sample criterion.

Pollutant Load Allocation

Pollutant load allocations were developed using FDC and LDC methods. To establish the subwatershed targets, TMDL calculations and associated allocations were developed for the most-downstream sampling location in each subwatershed. This establishes a distinct TMDL for each 303(d)-listed water body.

To calculate the bacteria load at the criterion for the segment, the flow rate at each flow exceedance percentile is multiplied by a unit conversion factor (*24,465,755 dL/ft3 * seconds/day*) and the *E. coli* criterion. This calculation produces the maximum bacteria load in the stream without exceeding the instantaneous standard over the range of flow conditions. *E. coli* loads are plotted versus flow exceedance percentiles as an LDC. The x-axis represents the flow exceedance percentile, while the y-axis represents bacteria load.

Two USGS gages outside the subwatersheds, Olmos Creek at Dresden Drive and San Antonio River at Loop 410 were chosen to conduct flow projections. The period of record for flow data used from these stations was 2002 through 2012. Pollutant loads were then calculated by multiplying the measured bacteria concentration by the flow rate and the unit conversion factor of *24,465,755 dL/ft3 * seconds/day*. The associated flow exceedance percentile is then matched with the measured flow. The observed bacteria loads are added to the LDC plots as points, and these points represent individual ambient water quality samples of bacteria. Points above the LDC show the bacteria instantaneous standard was exceeded at the time of sampling. Conversely, points under the LDC show the sample met the criterion.

The LDC approach recognizes that the assimilative capacity of a water body depends on the flow, and that maximum allowable loading varies with flow condition. Existing loading and loads that meet the TMDL water quality target can also be calculated under different flow conditions.

The load allocation goal for each subwatershed's area is based on data analysis using the geometric mean criterion since it is expected that achieving the geometric mean over an extended period of time will likely ensure that the single sample criterion will also be achieved.

Figure 7 represents the LDC for Menger Creek (1910D_01), which is based on *E. coli* bacteria measurements at sampling location 12693 (Menger Creek immediately upstream of Coliseum Road). The LDC shows that the geometric mean of observed *E. coli* loading exceeds the instantaneous and geometric mean water quality targets under all three flow conditions.

Figure 8 represents the LDC for Apache Creek (1911B_01), which is based on *E. coli* bacteria measurements at sampling location 18735 (Apache Creek at Brazos Street). The LDC shows that *E. coli* levels exceed the instantaneous and geometric mean water quality targets under all three flow conditions.

Figure 9 represents the LDC for Alazan Creek (1911C_01 & 1911C_02), which is based on *E. coli* bacteria measurements at sampling location 12715 (Alazan Creek at Tampico Street). The LDC shows that *E. coli* levels exceed the instantaneous and geometric mean water quality targets under all three flow conditions.

Figure 10 represents the LDC for San Pedro Creek (1911D_01 & 1911D_02), which is based on *E. coli* bacteria measurements at sampling location 18736 (San Pedro Creek at Probandt Street). The LDC shows that *E. coli* levels exceed the instantaneous and geometric mean water quality targets under all three flow conditions.

Figure 11 represents the LDC for Sixmile Creek (1911E_01), which is based on *E. coli* bacteria measurements at sampling location 12705 (Six Mile Creek at Roosevelt Avenue). The LDC shows that *E. coli* levels exceed the instantaneous and geometric mean water quality targets under all three flow conditions.

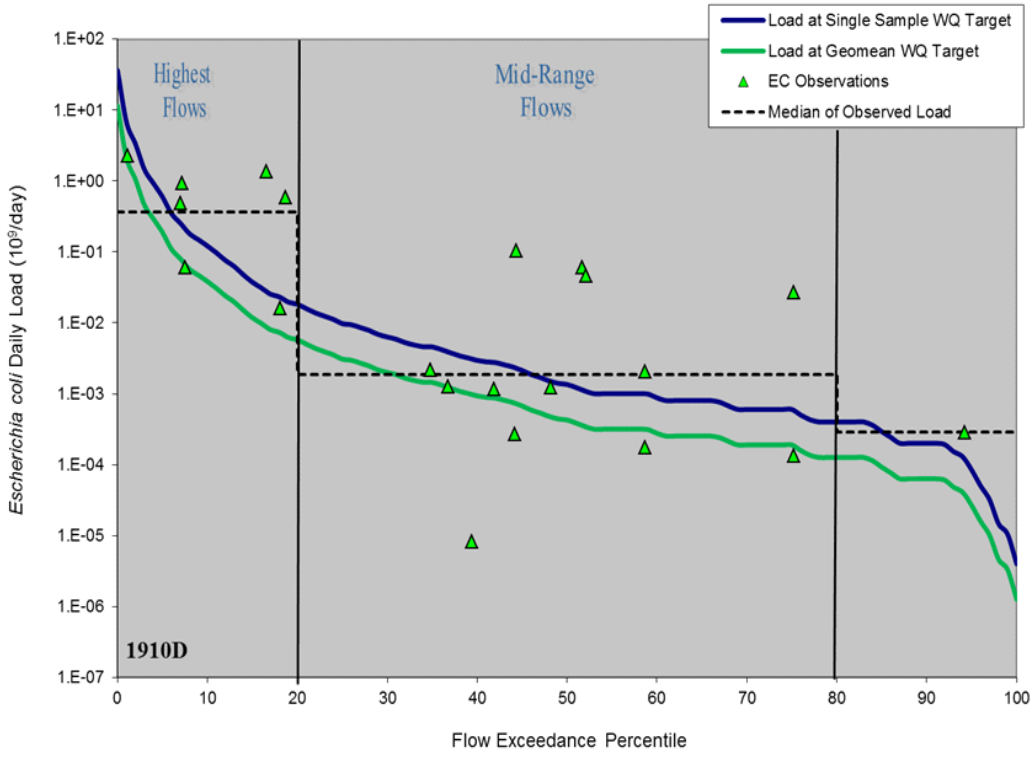

Figure 7. Load Duration Curve for Menger Creek (1910D_01)

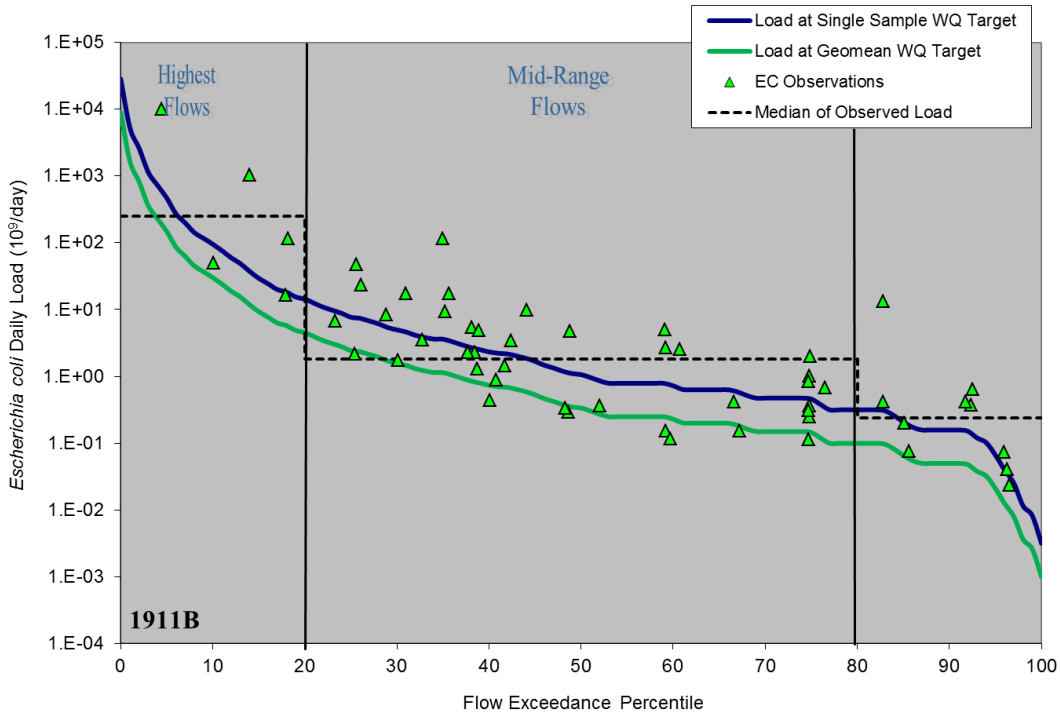

Figure 8. Load Duration Curve for Apache Creek (1911B_01)

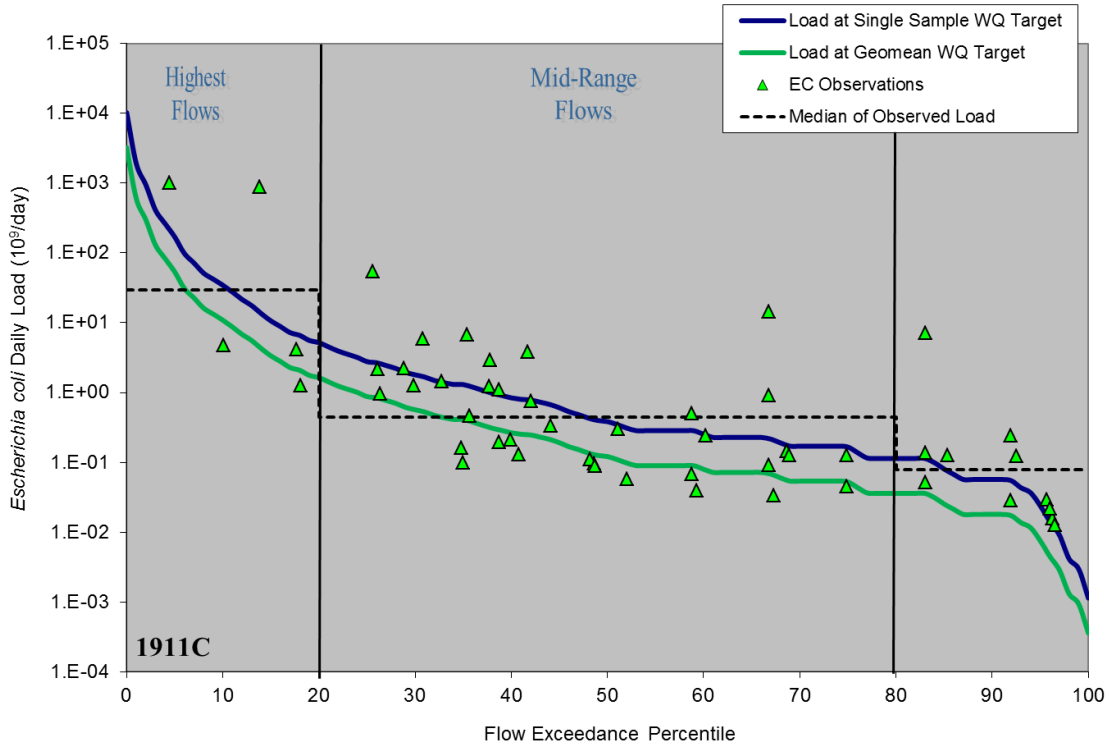

Figure 9. Load Duration Curve for Alazan Creek (1911C_01 & 1911C_02)

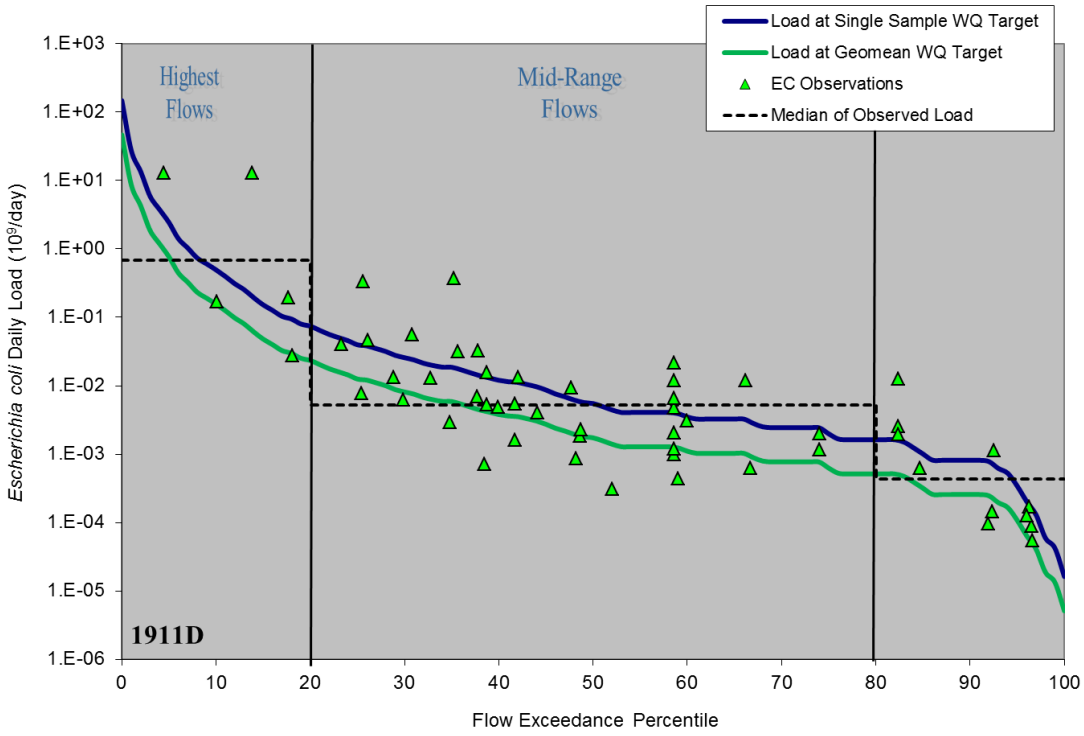

Figure 10. Load Duration Curve for San Pedro Creek (1911D_01 & 1911D_02)

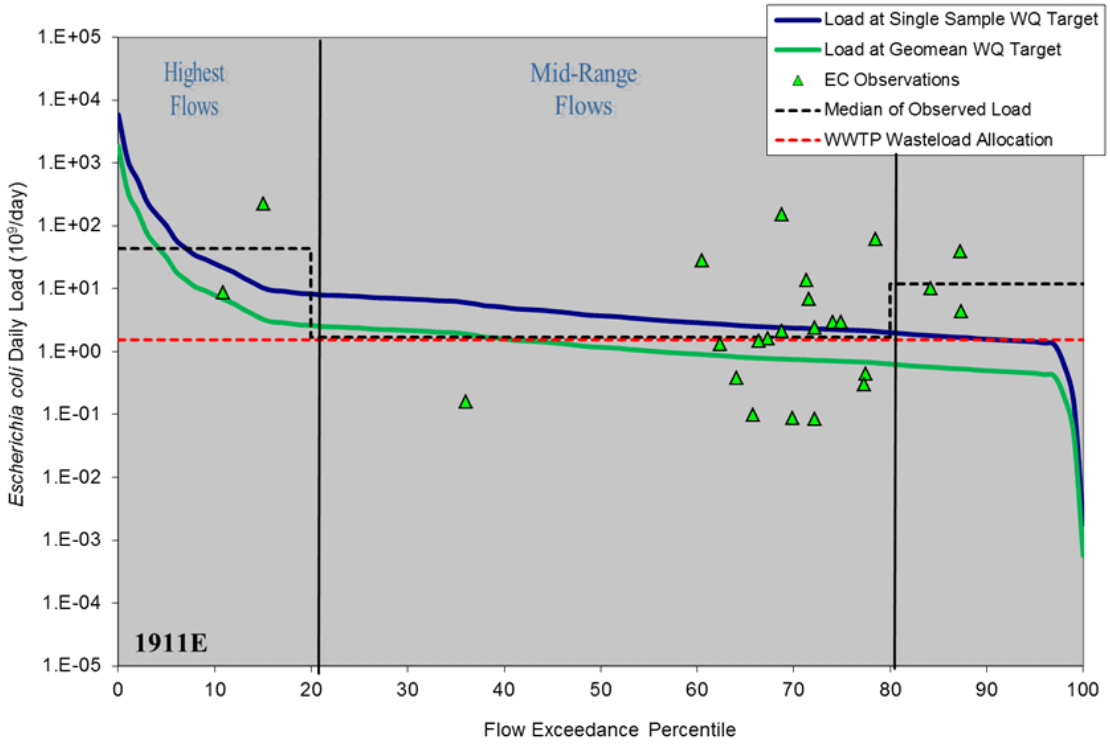

Figure 11. Load Duration Curve for Sixmile Creek (1911E_01)

Wasteload Allocation

TPDES-permitted facilities are allocated a daily waste load calculated as their permitted discharge flow rate multiplied by one half of the instream geometric mean water quality criterion. Only Sixmile Creek subwatershed has TPDES facilities which discharge into the segment. Table 10 summarizes the wasteload allocation (WLA) for the TPDES-permitted facilities within the subwatershed. The WLA for each facility (WLA_{WWTF}) is derived from the following equation:

WLA_{WWTF} = criterion/2 * flow * unit conversion factor (#/day)

Where:

criterion = 126 counts/dL for E. coli

flow (10^6 gal/day) = permitted flow

unit conversion factor = 37,854,120/10^6gal/day

There are no TPDES-permitted facilities which discharge into the watersheds of segments 1910D, 1911B, 1911C, and 1911D. When there are no TPDES WWTFs discharging into the contributing watershed of a SWQM station, then the WLA_{WWTF} is zero (EPA 2007). Compliance with the WLA_{WWTF} will be achieved by adhering to the discharge limits and disinfection requirements of TPDES permits.

Table 10. Wasteload Allocations for TPDES-Permitted Facilities

TPDES Number	NPDES NUMBER	Facility Name	Final Permitted Flow (MGD)	WLA_{WWTF} (Billion MPN/day)
03955-000	TX0116114	Kelly Air Force Base	1	2.38
04117-000	TX0069931	San Antonio Equipment Repair and Maintenance Yard	n/a	n/a

Stormwater

Stormwater discharges from MS4, industrial, and construction areas are considered permitted or regulated point sources. Therefore, the WLA calculations must also include an allocation for regulated stormwater discharges ($WLA_{Stormwater}$). A simplified approach for estimating the WLA for these areas was used in the development of the TMDL due to the limited amount of data available, the complexities associated with simulating rainfall runoff, and the variability of stormwater loading.

The percentage of the subwatersheds that are under the jurisdiction of stormwater permits (i.e., defined as the area designated as urbanized area in the 2010 US Census) was used to estimate the amount of the overall runoff load to be allocated as the regulated stormwater contribution in the $WLA_{Stormwater}$ component of the TMDL. The watershed area is 100 percent covered by the MS4 permit. The load allocation (LA) component of the TMDL corresponds to direct nonpoint source runoff and is the difference between the total load from stormwater runoff and the portion allocated to $WLA_{Stormwater}$. These allocation values are found in Table 11.

Load Allocation

The LA is the sum of loads from unregulated sources. Since the entirety of the subwatershed is within the urbanized area, a negligible LA was incorporated into the TMDL equation, to account for potential wildlife contributions, and other minor sources that are difficult to measure.

Allowance for Future Growth

As described in the original TMDL document, future growth of existing or new point sources is not limited by this TMDL as long as the sources do not cause indicator bacteria to exceed the limits. The assimilative capacity of streams increases as the amount of flow increases. Consequently, increases in flow allow for additional indicator bacteria loads if the concentrations are at or below the contact recreation standard. New or amended permits for wastewater discharge facilities will be evaluated case by case.

To account for the high probability that new additional flows from WWTFs may occur in this segment, a provision for future growth was included in the TMDL calculations by estimating regulated flows to year 2050 using population projections completed by the Texas Water Development Board (TWDB 2013). A summary of the methods used to predict wastewater flow capacity based on population growth is included in the Technical Support Document for reference.

TMDL Calculations

Table 11 summarizes the estimated maximum allowable load of *E. coli* for the AUs in this project.

The final TMDL allocation required to comply with the requirements of 40 Code of Federal Regulations (CFR) 130.7 is summarized in Table 12. The future capacity for WWTFs has a non-zero value for the Sixmile Creek watershed that contains a TPDES permitted facility. The other segments have their entire drainage area serviced by WWTFs that discharge outside the watershed boundary. TMDL values and allocations in Table 12 are derived from calculations using the existing water quality criteria for *E. coli*. Figures 12 through 18 show these allocations graphically. Designated uses and water quality criteria for these water bodies are subject to change through TSWQS revisions. Figures 12 through 18 were developed to show how assimilative capacity, TMDL calculations, and pollutant load allocations change in relation to a number of hypothetical water quality criteria. The equations from these figures allow the calculation of new TMDLs and pollutant load allocations based on any potential new water quality criteria for *E. coli.*

Table 11. *E. coli* TMDL Summary Calculations for Subwatershed Segments

Assessment Unit	Stream Name	Indicator Bacteria	TMDL[a] (Billion MPN/day)	WLA_{WWTF}[b] (Billion MPN/day)	$WLA_{STORMWATER}$[c] (Billion MPN/day)	LA[d] (Billion MPN/day)	MOS[e] (Billion MPN/day)	Future Growth[f] (Billion MPN/day)
1910D_01	Menger Creek	*E. coli*	0.0404	0.0	0.0374	0.001	0.0020	0.0
1911B_01	Apache Creek	*E. coli*	31.78	0.0	30.19	0.001	1.59	0.0
1911C_01	Alazan Creek	*E. coli*	3.99	0.0	3.79	0.00035	0.2	0.0
1911C_02		*E. coli*	7.49	0.0	7.12	0.00065	0.37	0.0
1911D_01	San Pedro Creek	*E. coli*	0.061	0.0	0.058	0.00037	0.003	0.0
1911D_02		*E. coli*	0.104	0.0	0.098	0.00063	0.005	0.0
1911E_01	Sixmile Creek	*E. coli*	9.66	2.38	5.44	0.001	0.48	1.36

[a] *Maximum allowable load for the highest flow range (0 to 30th percentile flows)*
[b] *Sum of loads from the WWTF discharging upstream of the TMDL station. Individual loads are calculated as permitted flow*126/2 (E. coli) MPN/100mL*conversion factor*
[c] $WLA_{Stormwater}$ *= (TMDL – MOS - WLA_{WWTF})*(percent of drainage area covered by stormwater permits)*
[d] *LA= TMDL – MOS –* WLA_{WWTF} *–* $WLA_{Stormwater}$ *– Future Growth*
[e] *MOS= TMDL x 0.05*
[f] *Projected increase in WWTF permitted flows*126/2*conversion factor*

Table 12. Final TMDL Allocations

Assessment Unit	TMDL[a]	WLA_{WWTF}[b]	$WLA_{Stormwater}$	LA	MOS
	(Billion MPN/day)				
1910D_01	0.0404	0.0	0.0374	0.001	0.0020
1911B_01	31.78	0.0	30.19	0.001	1.59
1911C_01	3.99	0.0	3.79	0.001	0.2
1911C_02	7.49	0.0	7.12	0.001	0.37
1911D_01	0.061	0.0	0.058	0.001	0.003
1911D_02	0.103	0.0	0.098	0.001	0.005
1911E_01	9.67	3.74	5.44	0.001	0.48

[a] *TMDL=* WLA_{WWTF} *+* $WLA_{Stormwater}$ *+ LA + MOS*
[b] WLA_{WWTF}*=* WLA_{WWTF} *+ Future Growth*

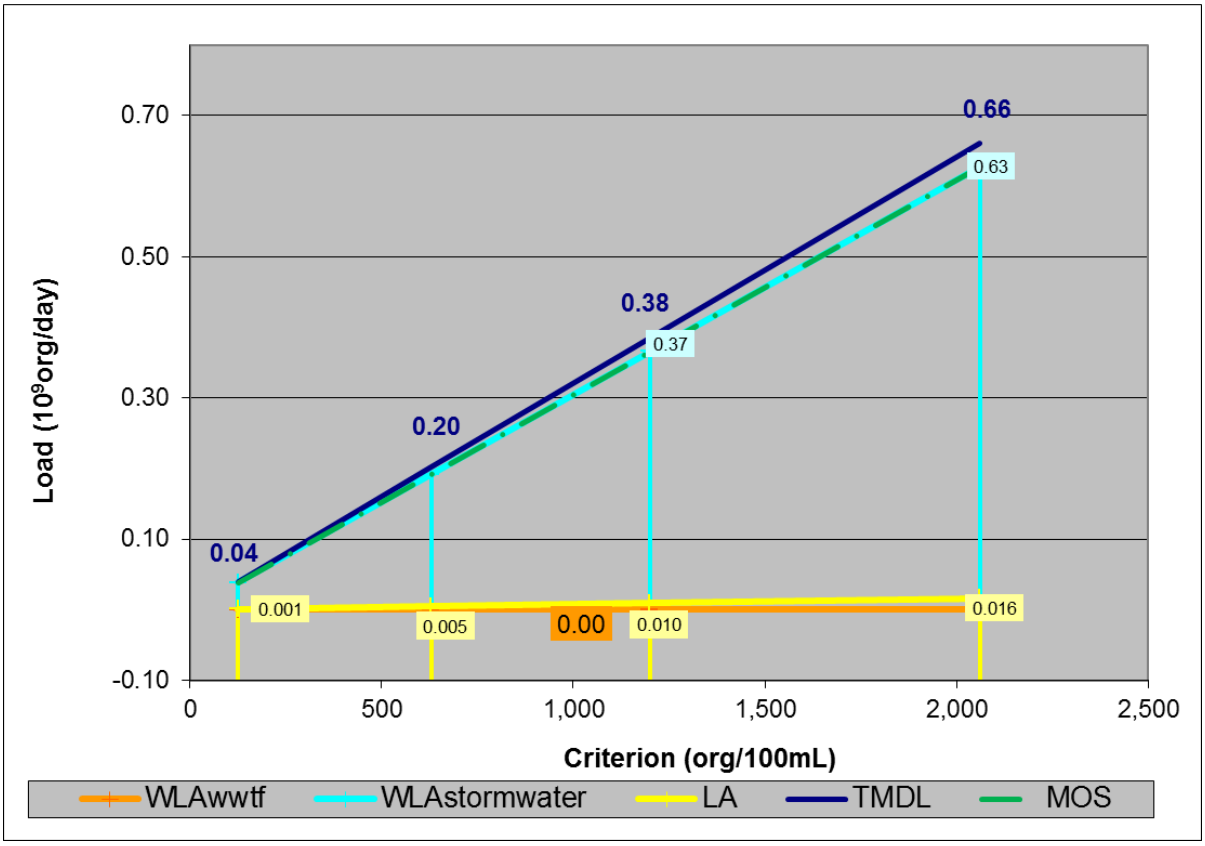

Figure 12. Allocation Loads for AU 1910D_01 as a Function of Water Quality Criteria

Equations for Calculating New TMDL and Allocations

$$\text{TMDL} = \ 0.000321 \ * \ \text{Std} - 0.0$$
$$\text{MOS} = 0.05 * \text{TMDL}$$
$$\text{LA} = \ 0.000008 \ * \ \text{Std} + 0.0$$
$$\text{WLA}_{\text{Stormwater}} = \ 0.000305 \ * \ \text{Std} - 0.0$$
$$\text{WLA}_{\text{WWTF}} = \ 0.0$$

Where:
Std= Revised Contact Recreation criteria
LA= load allocation (unregulated source contributions)
$\text{WLA}_{\text{Stormwater}}$= wasteload allocation (regulated stormwater);
WLA_{WWTF}= wasteload allocation (regulated WWTF)

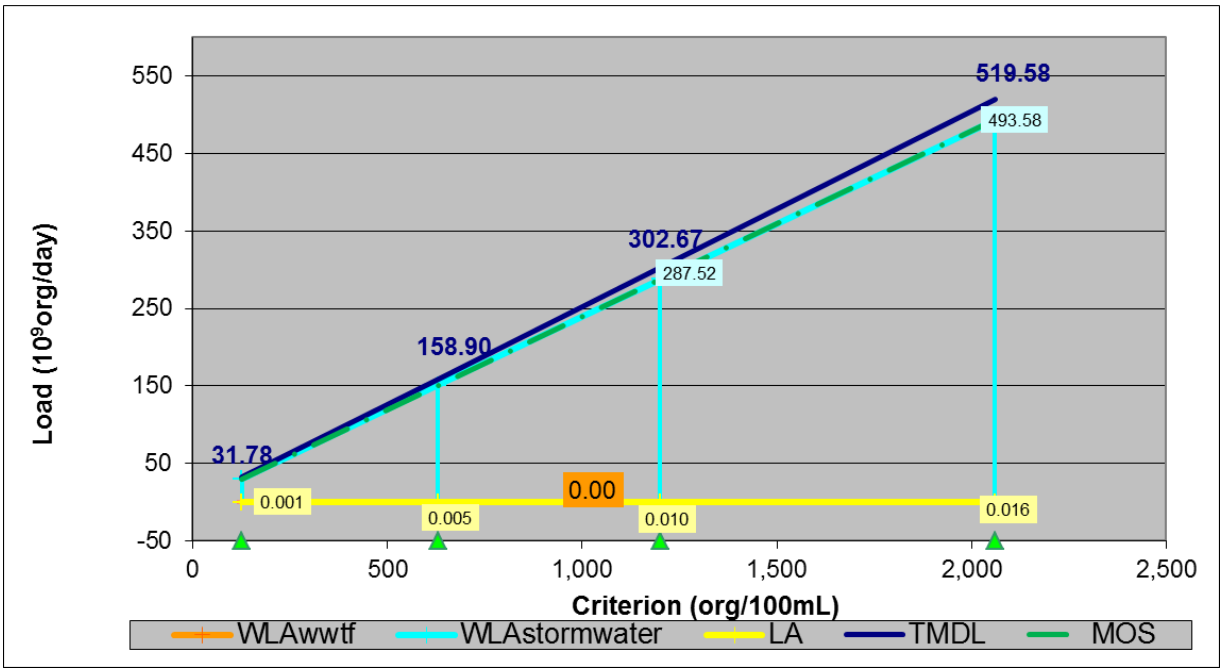

Figure 13. Allocation Loads for AU 1911B_01 as a Function of Water Quality Criteria

Equations for Calculating New TMDL and Allocations

$\text{TMDL} = \ 0.252 \ * \ \text{Std} - 0.0$
$\text{MOS} = 0.05 * \text{TMDL}$
$\text{LA} = \ 0.000008 \ * \ \text{Std} + 0.0$
$\text{WLA}_{\text{Stormwater}} = \ 0.2396 \ * \ \text{Std} - 0.0$
$\text{WLA}_{\text{WWTF}} = \ 0.0$

Where:
Std= Revised Contact Recreation criteria
LA= load allocation (unregulated source contributions)
$\text{WLA}_{\text{Stormwater}}$= wasteload allocation (regulated stormwater);
WLA_{WWTF}= wasteload allocation (regulated WWTF)

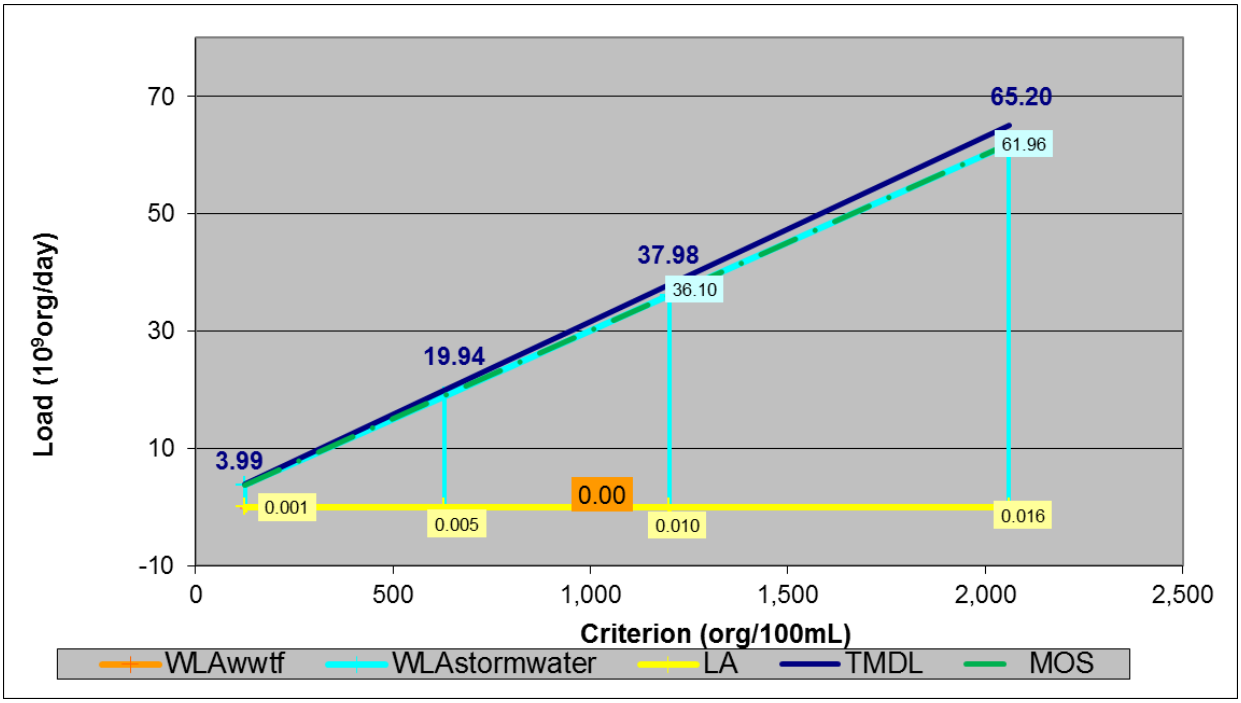

Figure 14. Allocation Loads for AU 1911C_01 as a Function of Water Quality Criteria

Equations for Calculating New TMDL and Allocations

$\text{TMDL} = \ 0.031652 \ * \ \text{Std} - 0.00$
$\text{MOS} = 0.05 * \text{TMDL}$
$\text{LA} = \ 0.000008 \ * \ \text{Std} + 0.0$
$\text{WLA}_{\text{Stormwater}} = \ 0.03008 \ * \ \text{Std} - 0.0$
$\text{WLA}_{\text{WWTF}} = \ 0.0$

Where:
Std= Revised Contact Recreation criteria
LA= load allocation (unregulated source contributions)
$\text{WLA}_{\text{Stormwater}}$= wasteload allocation (regulated stormwater);
WLA_{WWTF}= wasteload allocation (regulated WWTF)

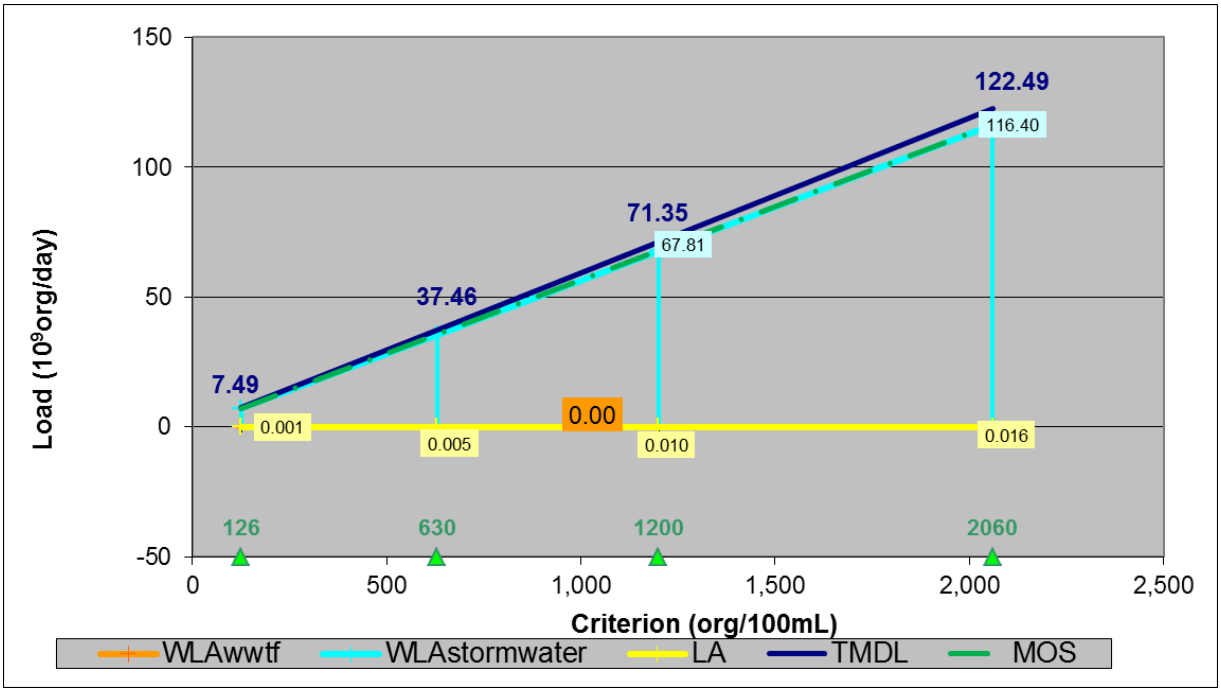

Figure 15. Allocation Loads for AU 1911C_02 as a Function of Water Quality Criteria

Equations for Calculating New TMDL and Allocations

$\text{TMDL} = \ 0.05946 \ * \ \text{Std} - 0.0$
$\text{MOS} = 0.05 * \text{TMDL}$
$\text{LA} = \ 0.000008 \ * \ \text{Std} + 0.0$
$\text{WLA}_{\text{Stormwater}} = \ 0.0565 \ * \ \text{Std} - 0.00$
$\text{WLA}_{\text{WWTF}} = \ 0.0$

Where:
Std= Revised Contact Recreation criteria
LA= load allocation (unregulated source contributions)
$\text{WLA}_{\text{Stormwater}}$= wasteload allocation (regulated stormwater);
WLA_{WWTF}= wasteload allocation (regulated WWTF)

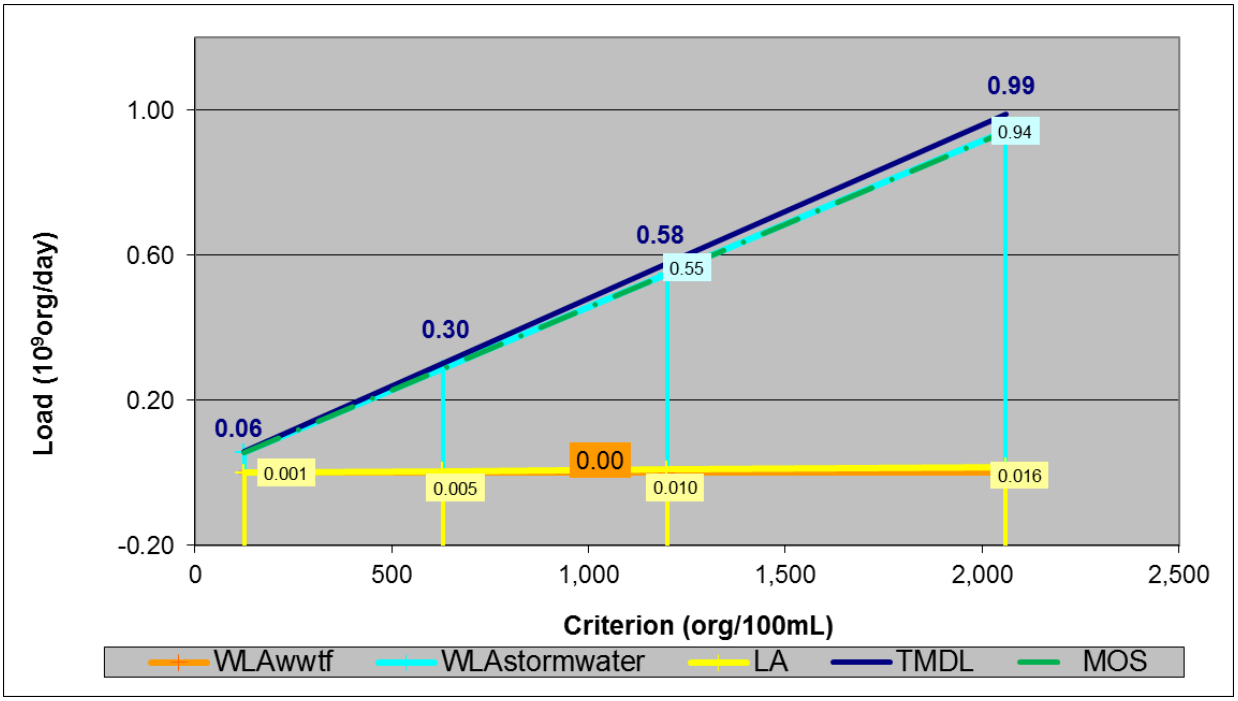

Figure 16. Allocation Loads for AU 1911D_01 as a Function of Water Quality Criteria

Equations for Calculating New TMDL and Allocations

$$\text{TMDL} = 0.000481 * \text{Std} - 0.0$$
$$\text{MOS} = 0.05 * \text{TMDL}$$
$$\text{LA} = 0.000008 * \text{Std} + 0.0$$
$$\text{WLA}_{\text{Stormwater}} = 0.000458 * \text{Std} - 0.0$$
$$\text{WLA}_{\text{WWTF}} = 0.0$$

Where:
Std= Revised Contact Recreation criteria
LA= load allocation (unregulated source contributions)
$\text{WLA}_{\text{Stormwater}}$= wasteload allocation (regulated stormwater);
WLA_{WWTF}= wasteload allocation (regulated WWTF)

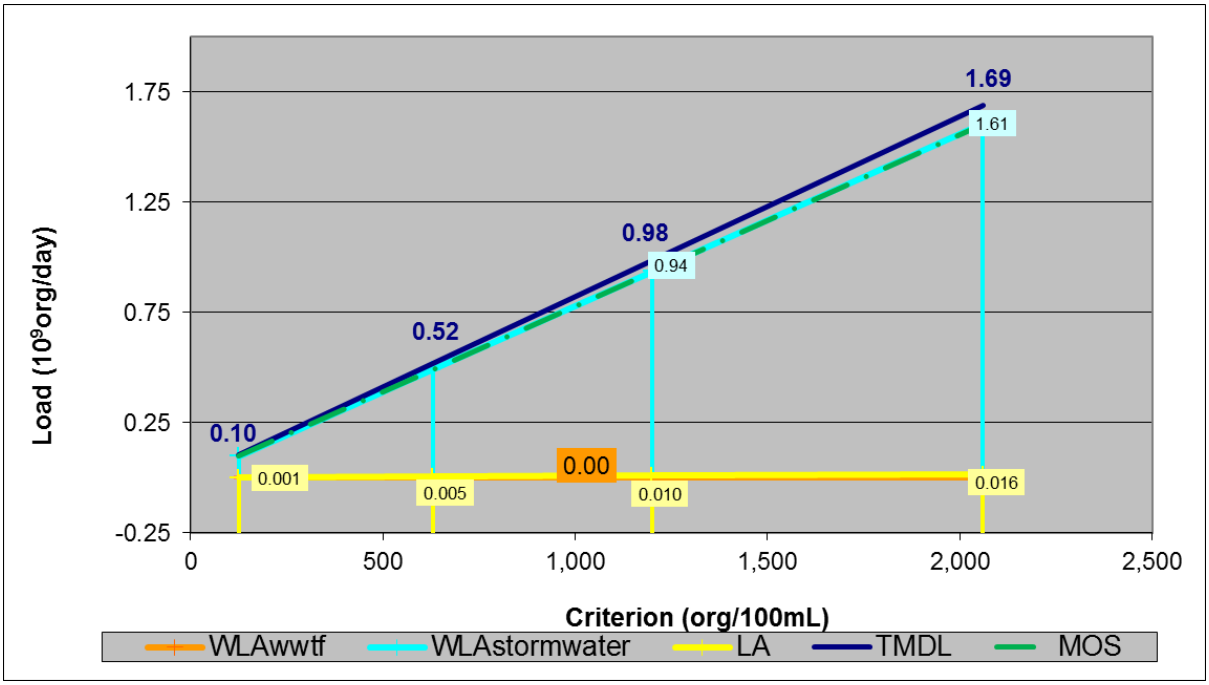

Figure 17. Allocation Loads for AU 1911D_02 as a Function of Water Quality Criteria

Equations for Calculating New TMDL and Allocations

$$\text{TMDL} = \ 0.000821 \ * \ \text{Std} - 0.0$$
$$\text{MOS} = 0.05 * \text{TMDL}$$
$$\text{LA} = \ 0.000008 \ * \ \text{Std} + 0.0$$
$$\text{WLA}_{\text{Stormwater}} = \ 0.000781 \ * \ \text{Std} - 0.0$$
$$\text{WLA}_{\text{WWTF}} = \ 0.0$$

Where:
Std= Revised Contact Recreation criteria
LA= load allocation (unregulated source contributions)
$\text{WLA}_{\text{Stormwater}}$= wasteload allocation (regulated stormwater);
WLA_{WWTF}= wasteload allocation (regulated WWTF)

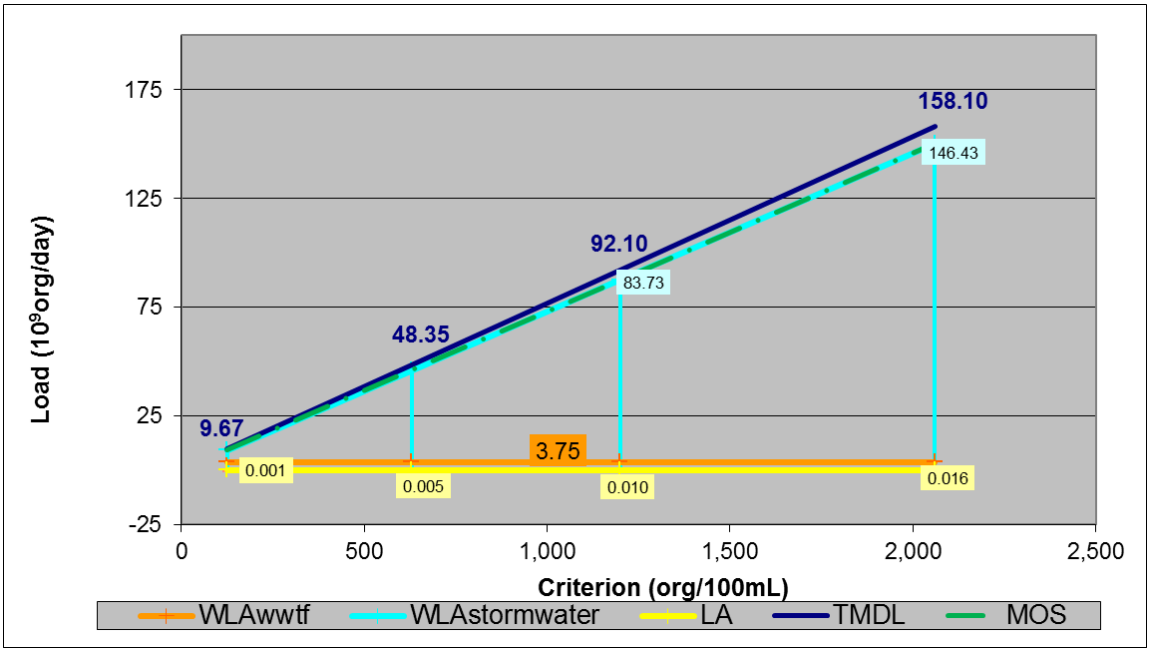

Figure 18. Allocation Loads for AU 1911E_01 as a Function of Water Quality Criteria

Equations for Calculating New TMDL and Allocations

$$\text{MDL} = \ 0.0767 \ * \ \text{Std} - 0.00029\text{MOS} = 0.05 * \text{TMDL}$$
$$\text{LA} = \ 0.000008 \ * \ \text{Std} + 0.0$$
$$\text{WLA}_{\text{Stormwater}} = \ 0.0729 \ * \ \text{Std} - 3.7488$$
$$\text{WLA}_{\text{WWTF}} = \ 3.75$$

Where:
Std= Revised Contact Recreation criteria
LA= load allocation (unregulated source contributions)
$\text{WLA}_{\text{Stormwater}}$= wasteload allocation (regulated stormwater);
WLA_{WWTF}= wasteload allocation (regulated WWTF)

Seasonal Variation

Federal regulations (40 CFR §130.7(c)(1)) require that TMDLs account for seasonal variation in watershed conditions and pollutant loading. Seasonal variation was accounted for in these TMDLs by using more than four years of water quality data and by using the longest period of USGS flow records when estimating flows to develop flow exceedance percentiles.

For *E. coli*, six of the eight stations with six or more samples exhibited higher geometric mean concentrations for the warmer months than the colder months. Two stations, Station 12709 on Segment 1911D and Station 12705 on Segment 1911E, showed a statistically significant difference at the 95 percent confidence interval between the warmer and cooler months, as shown in Table 13.

Table 13. Seasonal Differences for *E. coli* Concentrations

Segment	Station ID	Indicator	Warm Months		Cold Months		p-value
			n	Geomean (MPN/100 ml)	n	Geomean (MPN/100 ml)	
1910D	12693	EC	9	613.55	9	1246.93	0.55
1911B	12710	EC	3	324.08	3	837.77	0.23
	15707	EC	3	1099.03	3	1309.67	0.92
	18735	EC	22	623.17	20	474.32	0.52
	20604	EC	3	477.98	3	2981.22	0.48
	20605	EC	3	358.82	3	2229.09	0.45
	20606	EC	3	371.05	3	2356.24	0.25
1911C	12715	EC	20	354.76	20	281.01	0.60
	12716	EC	3	300.68	3	84.80	0.31
	12718	EC	3	473.38	3	250.66	0.77
	18737	EC	3	321.16	3	321.45	1.00
	20344	EC	3	505.02	3	826.95	0.75
	20345	EC	3	1402.72	3	391.11	0.12
1911D	12709	EC	8	235.33	10	18.13	0.01
	18736	EC	21	424.35	20	262.16	0.30
	20116	EC	3	353.09	3	564.48	0.70
	20117	EC	11	736.03	13	423.31	0.18
	20119	EC	13	389.91	13	399.72	0.97
1911E	12705	EC	10	2324.67	10	99.87	0.00

EC: E. coli, n = number of samples
Highlighted rows correspond to stations for which the warm and cold datasets are significantly different at a 95% confidence interval.
p-value is based on a t-test conducted at each station using the log of the single sample concentrations.
All concentrations are in counts/dL; values less than the detection limit were treated in calculations as one-half the detection limit.
<www.ncdc.noaa.gov/data-access/land-based-station-data/land-based-datasets/climate-normals/1981-2010-normals-data>

Public Participation

The TCEQ maintains an inclusive public participation process. From the start of the investigation, the project team sought to ensure that stakeholders were informed and involved. Communication and comments from the stakeholders in the watershed strengthen TMDL projects and their implementation.

Regular stakeholder meetings have been held and TCEQ solicited stakeholder comments at each project milestone, while assisting stakeholders with communications. Texas AgriLife Research and the San Antonio River Authority are key partners in this project. As contractors to TCEQ, the University of Houston provides technical support and presentations at stakeholder meetings. Five coordination committee meetings were held between August 2013 and June 2014. Technical Subcommittee meetings were held on a monthly to bi-monthly bases between October 2013 and August 2014.

A stakeholder committee called the San Antonio Bacteria TMDL Advisory Group helped the TCEQ in developing the original TMDLs for the Upper San Antonio River. The responsibility of each stakeholder on the committee is to communicate project information and provide their personal/organization's perspective on all issues, knowledge of the watershed, comments and suggestions during the project, and solicit input from others. The group includes volunteer members who represent government, regulated facilities, agriculture, business, environmental, and community interests. This Advisory Group was consulted on the additions to these TMDLs through a public meeting June 11, 2015, where the results of the study were presented by the University of Houston project manager. The information was also presented to the Bexar Regional Watershed Management Group's Water Quality Focus Group June 26, 2015, and questions and comments were addressed during the meeting and in a follow up e-mail. A WQMP update tool will also be prepared and distributed to the Advisory Group as well as the general public through web-based notifications. This update can be found on the TCEQ project Web page for the Upper San Antonio River.

The TCEQ held a public comment meeting for the original TMDL document April 20, 2007, with a comment period from March 23, 2007 to April 23, 2007. Thirteen comments came in from the public, a majority of which came from SAWS. TCEQ project managers addressed all comments and questions, and made a few minor changes based on suggestions from SAWS. The EPA also submitted 13 questions and comments about the document. These were addressed, with minor errors being corrected.

Implementation and Reasonable Assurance

The segments covered by this addendum are within the existing Upper San Antonio River Bacteria TMDL project watershed. The San Antonio Bacteria TMDL Advisory Group and other stakeholders, with support from the TCEQ and Texas A&M AgriLife Research, have developed a plan to implement TMDLs with measures that reduce pollution. The implementation plan identifies the management measures needed to reduce bacteria, as well as a timeline for implementation.

Please refer to the original TMDL document for additional information on implementation and reasonable assurance.

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